

AVIATION WEEK

A MCGRAW-HILL
PUBLICATION

December 16, 1957 75 cents

Next Space Steps:

- Getting Man Back
- Man's Flight Role



Dassault Etendard VI



Convair's Super Sonic Delta - B-58, F-102A, F-106

KEYSTONES OF AMERICAN AIR POWER

Convair, by developing and perfectly delivering aircraft, has provided significant new systems of capability for both the Strategic and Defense missions of the U.S. Air Force.

America's first supersonic Bomber, the B-58, was developed and is being built at Convair-Puget Western for the Strategic Air Command. America's first supersonic, all-weather Interceptor, the F-102A, and its advanced successor the F-106 were designed and are being built at Convair-San Diego for the Air Defense Command.

CONVAIR A DIVISION OF GENERAL DYNAMICS CORPORATION



VICKERS helps scan new horizons...

by turning 3 tons with 13 pounds

The giant "rotor", rotating atop the Lockheed Super Constellation, contains an airborne radar antenna. It requires a high-power, low-angle, high driving mechanism for the scanning operation. This mechanism must be compact, dependable, able to provide constant speed regardless of load change... and operate on a positive source from the aircraft power supply.

The small (approximately 25 pounds) **VICKERS PASCAGE DRIVE** more than meets the drive requirements of the large 320 foot diameter antenna. And - like similar Vickers hydraulic components used in the Constellation for other purposes - provides proven dependability spanning many years of aircraft applications.

Drive components include:

- Modulating flow control valve maintains selected constant speed, regardless of load change
- Valve solves the problem of motor rotation direction and speed
- Fixed displacement hydraulic motor for driving the antenna

It's the job. Bullets don't do for further information about this system.

VICKERS INCORPORATED

DIVISION OF SHEET METAL CORPORATION

Aero Hydraulic Division—Engineering, Sales and Service Offices:

ADMINISTRATIVE and ENGINEERING CENTER
Department 1442 • Detroit 35, Michigan

TORRANCE, CALIFORNIA
3301 Louisa Blvd., P.O. Box 2003 • Torrance, Calif.

• Hickory, Long Island, N.Y., 11550 80th Ave.

Aero Hydraulic Division District Sales and Service Offices

• Arlington, Texas P.O. Box 111 • Seattle 4 Washington 800 5th Ave. South • Washington 3 D.C. 4007 14th Street N.W.

• Chicago 1700 N. LaSalle • St. Louis 1100 N. 1st • St. Paul 1100 N. 1st • Tulsa 1100 N. 1st • Dallas 1100 N. 1st

• Los Angeles 1100 N. 1st • The Bronx 1100 N. 1st • New York 1100 N. 1st • Philadelphia 1100 N. 1st

1959

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1927



THEN-WALL magnesium casting for the Republic model 16 produced by Dow.

QUALITY MAGNESIUM CASTINGS

for aircraft and missiles

Sand, Permanent Mold, Plaster Castings

YOU NAME THE CASTING! Dow can supply you with ordinary and extraordinary shapes or sizes. Specialized techniques rapidly produce your standards and specifications. Heat, as high or low as you want, or elevated temperature use the best and most accurate to your problems at Dow magnesium castings! Contact your nearest Dow sales office for additional references. The more castings, the more success. Foundry Sales, Blue City, Michigan.

YOU CAN DEPEND ON **DOW**

AVIATION CALENDAR

- Dec. 16-17-Aviation Conference on the status of Engineers and Scientists Unions at the Missouri Campus, Columbia, Mo.
- Dec. 18-19-Air Traffic Control Symposium "The Means and Methods of the Airways Modernization Study," sponsored by Franklin Institute, Shikano Hotel, Philadelphia, Pa.
- Dec. 17-2nd Wright Brothers Lecture-Hypersonic Thrust and the Rocket Problem II, John A. McCauley, State of Illinois Building, Indianapolis, Ind.
- Dec. 18-Can-Turkey Development, speech by Rex A. S. B. Spang, UNLV, Air Development & Material Center at Fort Monmouth, Philadelphia, Pa.
- Jan. 6-4th Fourth National Symposium on Human Reliability and Quality Control, Hotel Statler, Washington D. C.
- Jan. 9-10-Meeting of Airline Personnel, Warming Industry & Air Column, Ford was, Nelson Committee, Philadelphia, Roosevelt Hotel, Los Angeles, Calif.
- Open to public each Jan. 9. Those wishing to make presentations need write to Air Transport Union, Washington D. C. by Dec. 20.
- Jan. 11-17-1955 Annual Meeting Society of Automotive Engineers, Sheraton-Cadillac and Hotel Statler, Detroit, Mich.
- Jan. 18-Mar. 14-Lecture series on Space Technology, sponsored by University of California and Raza W. Hollister Corp. to be held in Los Angeles, San Diego and San Francisco. For details contact University of California Extension Dept. of Conference and Special Activities, Los Angeles 24, Calif.
- Jan. 14-15-Yacht Industry Day & Symposium sponsored by Insurance Society of America (Boston Commercial Yacht and Fairfield County Yacht) Hotel Statler, Boston, Mass.
- Jan. 20-Texas Marine, Petroleum Workers Union Sustain The Committee Against California Initiative of (Continued on page 6)

AVIATION WEEK • DECEMBER 16, 1957

Vol. 47, No. 34

Published weekly with an additional issue in 1958. The Aviation Week International office is at 1230 Avenue of the Americas, New York 20, N. Y. Telephone BR 7-1230. Second-class postage paid at New York, N. Y., and at additional mailing offices. Postmaster: Send address changes in New York City to Aviation Week, Inc., 1230 Avenue of the Americas, New York 20, N. Y. Outside New York City to Aviation Week, Inc., 1230 Avenue of the Americas, New York 20, N. Y. Second-class postage paid at New York, N. Y., and at additional mailing offices. Postmaster: Send address changes in New York City to Aviation Week, Inc., 1230 Avenue of the Americas, New York 20, N. Y. Outside New York City to Aviation Week, Inc., 1230 Avenue of the Americas, New York 20, N. Y.

Subscription rates: Single copy, 50¢. Annual subscription, \$5.00. Two-year subscription, \$9.50. Single copy, 50¢. Annual subscription, \$5.00. Two-year subscription, \$9.50. Single copy, 50¢. Annual subscription, \$5.00. Two-year subscription, \$9.50.

The Many-Sided Career of Early Bird Robinson



Building this 30 h.p. plane in 1908 led to Robinson's meeting with Glenn Curtiss and a long association with the great aviation pioneer.



This early sport plane, designed and built in 1912 by Robinson, averaged 81 m.p.h., weighed only 600 pounds.



High Robinson (far left) at the launching of an early Curtiss biplane at San Diego in 1911. Glenn Curtiss designed it at far right.

High Robinson's skill as a flyer was enough to win him lasting aviation fame, but when you add his abilities as a designer and builder of aircraft, you complete the picture of a many-talented man.

Robinson built a one-cylinder automobile in 1896, a dirigible in 1906 and a tractor-type monoplane in 1908. This airplane led to his meeting Glenn Curtiss. For many years afterward, Robinson helped Curtiss design, build and fly the early and famous Curtiss aircraft.

Robinson was a famous early-day exhibition flyer, making more than 900 appearances here and abroad. He was among the first to fly air mail, making a real run between Minneapolis and Rock Island, Ill., in 1911. He demonstrated a pioneer dive bombing technique with grapefruit "bombs" in California; operated a flying school in France; and built a sport plane that weighed only 600 pounds.

Altogether, Robinson flew more than 8,000 hours in compiling a useful and enviable record as a daring and resourceful aviator.

● A pioneer in research and development of aviation fuels, Phillips Petroleum Company is, today, a foremost supplier of high octane gasoline for commercial, private and military aircraft. In step with the future, Phillips is a leading producer of super-performance jet fuels for the latest designs in turbo-prop and jets. And Phillips research continues to lead the way for development of fuels for the smooth of tomorrow.



AVIATION DIVISION • PHILLIPS PETROLEUM COMPANY
Bartlesville, Oklahoma

"SANDWICHES" FOR A LIGHT LAUNCH

Every pound, every ounce of weight eliminated in plane and missile structures means increased fuel and instrumentation loads...

The phenomenally high strength-to-weight ratio of bonded sandwich components...utilizing metals or reinforced fiberglass...has given design engineers a fabulous weapon to help combat the "overweight" problem...

Narmco's long-accumulated experience in the design and development of bonded primary or secondary sandwich structures, regardless of the size, shape or complexity, is available to you...Narmco Manufacturing Co. welcomes the opportunity to direct its technical skills to the solution of your missile structural problems.

*"If it's a complex sandwich design...
Narmco specialists can build it!"*



NARMCO

**NARMCO
MANUFACTURING CO.**

3150 Baltimore Drive
La Mesa, California

The M3 Tone Bomb Computer System is standard equipment on the Air Force's operational fighter-bombers. It enables attack on "targets of opportunity" and—of all fighter-bomber systems—it provides superior accuracy and a flight pattern least vulnerable to counter measures. Its design and configuration allow installation in any known fighter or bomber.

Researched, designed and mass produced by Mergenthaler Systems Engineering Division, this compact and efficient device is just one example of Mergenthaler's outstanding work on complex integrated systems, support equipment and special components.

This accumulated experience in systems engineering, together with Mergenthaler's extensive manufacturing facilities in both the United States and NATO countries, is of very real importance to the nation's defense projects... Mergenthaler Liaison Company, 29 Hyman Street, Brooklyn 5, New York

MERGENTHALER

Mergenthaler is currently active in:
systems engineering • advanced bombing systems • analogue and digital computers • infra-red equipment • electronics • optics • high speed photography • ballistics • ordnance control systems • missile guidance • servo-mechanisms • thermodynamics • mechanical and electro-mechanical engineering • magnetic theory • metallurgy



Some facilities are easily measured. Like floor space. Grumman has 3,600,000 square feet of it, all in use. And the runways at Bethpage and Flamingo River, Long Island, N.Y., and at Stuart, Fla. They stretch a total of 9 miles.

You can size up other Grumman facilities, too. Like design rooms. Wind tunnels. Analog computers. Altitude chambers. Test-flight simulators. Techniques in forming, machining and welding. Quality control practices. Sociologists. Research with comets. Or the process that mills metal chemically.

You can see the scope of Grumman facilities other places. At the cadet-attended jet engine test stands. On the assembly line. In the air where missiles and other armaments are test-fired. Or at the duty places around the world where Grumman field service is available 24 hours a day.

Anything else? Yes, Grumman's most important facility. Its people. How do you measure them? Look at any Grumman plane. The amphibious SA-16 Albatross of air rescue fame. The S2F-1 Tracker, world's first anti-submarine aircraft capable of performing the complete search-and-attack assignment. The radsonic WF-2 Tiger "early warning" aircraft. The F11F-1T, the Navy's only transonic fighter-bomber. Or the supersonic F11F-1 Tiger, the first fighter to incorporate into its design the area rule (spoon bottle) technique. That's the measure of Grumman people. And has been for 27 years in the production of over 24,000 planes.

GRUMMAN FACILITIES



GRUMMAN AIRCRAFT ENGINEERING CORPORATION

Bethpage • Long Island • New York

Air Superiority Fighters • Anti-submarine Aircraft • Jet Trainers

Air Transporters • Nuclear Research • Assault Truck Bodies

Hydrofoil Research • Grumman Boats

CRYOGENIC PUMP IS NOTEWORTHY NEW INDUSTRY DEVELOPMENT

A product of Sundstrand-Denver, it has a demonstrated capability of pumping liquid nitrogen at pressures over 3000 psi at speeds of over 3500 RPM.

Piston type, extremely compact and lightweight, it has been under experimental development for a year and is suitable for pumping liquid gases such as nitrogen and oxygen. Sustained operating periods have been obtained repeatedly without any form of lubrication.

The pump is a design modification of a Sundstrand hydraulic motor which is made in many sizes and these other larger capacity pumps can be provided with relatively little development.

The pump shown here has six axial pistons and is of fixed displacement type. Metal parts have been selected to be compatible with liquid nitrogen. Minor material changes can be incorporated for satisfactory operation with the use of liquid oxygen.

The result of precision engineering and careful testing, these pumps appear to be the solution to many of the high power-to-weight problems encountered with missiles, rockets and high performance fighter planes, and will prove highly useful for aircraft cooling systems and ground support equipment. Variation in orientation, size, mounting and assembly of these self-contained units can be supplied to suit your individual needs. For further information on using these pumps to solve your cryogenic pumping problems contact: Applications Department, Sundstrand-Denver.



PERFORMANCE DATA
SUNDSTRAND-DENVER CRYOGENIC PUMP

Displacement	0.020 cu in./rev.
Capacity @ 3500 RPM	1.75 gpm
Horsepower @ 3500 RPM	3.9 HP
Volume Efficiency @ 3000 PSI	99%
Weight	2.8 lbs
AND Mounting Flange	10000 Type X
Dwg No	ED699



SUNDSTRAND-DENVER

3410 W. 76th Avenue • Denver 21, Colorado

A DIVISION OF SUNDSTRAND MACHINE TOOL COMPANY

Complete design, development and precision manufacturing facilities



CAPABILITY FOR THIS MISSILE AGE



If you have a problem requiring outdoor and exacting capabilities, invite us for a free Precision Analysis.

Sundstrand-Denver's 130 men creative team of engineers and technicians, precision production facilities, complete and separate prototype shop, laboratories, testing and heat treating equipment have gained for it recognition as "Plant of the Year Award Winner 1967."

In this new plant you'll find versatile, modern machines coupled with 50 years engineering, development and product manufacturing experience.

Here exacting control and coordination to expedite "on time delivery" is available to you.



SUNDSTRAND-DENVER

3410 W. 76th Avenue • Denver 21, Colorado

A DIVISION OF SUNDSTRAND MACHINE TOOL COMPANY

"First in constant speed drive"—Sundstrand Axleless, Rockford, Illinois

NOW

for the first time

LOW COMPRESSION SET

Butyl "O" RINGS



NEW

Another **LINEAR** first... a new, low compression-set Butyl Compound for use in "O" Rings. **LINEAR** Butyl Compound 7896-70 is a seal material that withstands compression set at elevated temperatures without being permanently deformed or losing its resiliency and its value as a seal. Also, Butyl withstands the chemical action of the non-flammable phosphate esters such as "Skydrol", "Hydrol", "Cellulene" and "Lundol".

YET, PROVEN

Extensive tests, under method "B" of the ASTM, show this new **LINEAR** compound develops only 30 to

40% compression set after 70 hours at 212°F, as compared to the usual 50 to 65% set experienced with previous Butyl compounds. This unusually good resistance to permanent deformation, combined with a tensile strength of 2000 psi and an elongation factor of 215%, make this material an outstanding one for all "O" Ring applications and other molded shapes where Butyl rubber's excellent qualities are desirable.

Whenever you have a seal problem that is tough to handle—look to **LINEAR** for an answer. Write, or ask the local representative for complete information on **LINEAR**'s new Butyl Compound 7896-70—today.



TP

echnical Publications

INDUSTRIAL GOVERNMENTAL

For Your Products

Whenever your tech data requirements, Hayes Technical Publications division offers you a complete service in the preparation of handbooks, brochures, catalogs, listings and directories.

Our organization has proudly the most complete self-contained facilities in the United States for "beginning to end" production requirements. In the past five years we have published over 1,500 technical research written to Government or industrial specifications, on drastic delivery schedules and under strict cost control.

Our staff of 415 employees occupies floor space in excess of 25,000 square feet. Through years of study, backed by extensive practical experience, and combined with various specialized skills in technical writing and illustration, we are your publications (the costumed technical content) is required. The Hayes Engineering Department supplements our research with additional engineering assistance whenever needed.

Our mechanical equipment includes all machinery necessary for production of high volume hot and cold type composition, with latest modern photo proofreading and equipment for top quality reproduction of art and text. These include a revolutionary Foto-Lite Camera, making possible composition of various type settings such as stock lists and directories... at a remarkable saving in cost.

If you are considering a technical handbook for your company whether in the field of electronics, machinery, liquids, electrical components (whatever your need) we will welcome an opportunity to discuss your projected publication requirements with you, at no cost or obligation.

ENGINEERS, SCIENTISTS, NEEDED—Hayes is an integral part of design, R&D, and maintenance facilities, including guided missile work. Good positions are open for structural design engineers, graduate engineering students, and commercial scientists. Write Personnel Division, Department 405, P. O. Box 2281.

ENGINEERS • DESIGNERS • MANUFACTURERS





OVER 125 AIRCRAFT TYPES NOW FLYING SIMMONDS FUEL GAGE SYSTEMS



New standard equipment on the Constellation and Viscount for leading world airlines, Simmonds PACITRON Fuel Gage Systems furnish dependable, accurate fuel measurement and fuel management on every flight. PACITRON fuel load control provides automatic control of fuel taken aboard in accordance with particular flight plan requirements.

In addition to load limit control, PACITRON offers three dual management functions: level switching, holdbacking, telescoping for remote readings, and control of gravity control.

Currently flying on more than 50 foreign airlines, PACITRON demonstrates Simmonds' continued leadership in "first in electronic fuel gaging."

Simmonds AEROCESORIES, INC.

General Offices: Tarrytown, N. Y.

Branch Offices: Detroit, Chicago • Boston, Mass. • Dallas, Texas • Miami, Florida • Minneapolis, Minnesota • New York, New York • Philadelphia, Pennsylvania • St. Louis, Missouri • San Francisco, California • Seattle, Washington • Salt Lake City, Utah • Simmonds Aerocessories of Canada Limited, Montreal



NEW LOW-COST COMPUTER WITH ADVANCED COMPUTING TECHNIQUES



The only desk-side electronic computer with direct programming and automatic positioning of decimal point



A few applications of the 610 Auto-Point Computer
 Factor Analysis
 Performance Evaluations
 Stress and Strain Calculations
 Data Reduction

Two exclusive features of the new IBM 610 Auto-Point Computer help make your engineering tasks more completely creative. First, direct programming; computation takes place as the program is being written, eliminating the need for separate program test runs. Second, automatic positioning of decimal point; the engineer is relieved of the burden of planning movement of the decimal point, greatly reducing problem-solving time.

The new Auto-Point Computer also gives you, among other valuable features, single-instruction square root, simultaneous division and multiplication, and highly flexible tape units. The IBM 610 was designed with reliability as a prime consideration; built-in self-checking provides assurance of accuracy. In addition, this low-cost electronic desk-side computer does not require air conditioning.

Discover today how the reliable IBM 610 can solve a wide range of scientific and engineering problems for your business. For details, simply call the local IBM representative.

IBM

TIME EQUIPMENT

TIME EQUIPMENT • DATA PROCESSING • ELECTRIC TRANSDUCERS • MILITARY PRODUCTS

Vanguard's Real Success

Now that the launch over the first successful test launching of the Project Vanguard test satellite has subsided, this project should be allowed to proceed at its pre-Sputnik leisurely pace. This country lost some 90 days ago the race in which Vanguard was our only last international prestige can be re-earned from Vanguard's achievement even when its satellite is orbiting, although valuable scientific data can still be harvested from the program.

But there are two aspects of the Vanguard's initial test phase that inspire important lessons for our future progress. If these lessons are taken to heart, even Vanguard's failure could be an educational success.

First is the full and plain plan of publicity that has been focused on Vanguard near Sputnik I dashed into space. This spotlight generated its maximum illumination during the failure of the Vanguard launching at Cape Canaveral early in December. For the first time since the missile and satellite program began, the American public was fully informed within the limits of genuine military security what was actually happening on the Vanguard program.

Because the test was a failure, there has been a kite and cry from the usual proponents of space success that the lid be clamped on tight on all Vanguard information. If the test had been successful there would have been a most reasonable tale told for the information effort.

But now, there is even talk of separating Defense Department officials who did a superb on-the-spot job of making information available at Cape Canaveral. Nothing could be more ridiculous. Merwyn Sender, Assistant Secretary of Defense for Public Affairs, and his deputy, Herschel Schofield, deserve a commendation for the way they handled the free flow of information from Vanguard. Far from being demoralized, this flow of information served a variety of useful purposes:

- Prevent the American public from ever again finding itself facing the jaw-dropping claims of Soviet achievements such as the Sputnik landings.
- Provide the American taxpayer and voter with a realistic understanding of the high and costly job involved in achieving the scientific progress required to maintain our military strength and civilian economy.
- Educate the American working press and mass communications media in the same field so that they can report in a more accurate, sophisticated and balanced manner and avoid the senseless pendulum swings from unbridled optimism to hopeless despair.
- Convince the Administration and those that will succeed it that government cannot operate effectively as a democracy either by concealing vital facts from the voters and taxpayers that support it or by promoting a steady glow of rose optimism.

Most important of these is the long and arduous task of educating working press men and the American public on the hard facts of scientific development progress. The failure of the first Vanguard firing, while not surprising to technicians either here or abroad, rendered some of the them and "naïve" atmosphere with which both nontechnical newsmen and the American public regarded development of aircraft, missiles and space vehicles.

The Vanguard failure has begun to teach them that

successful scientific developments are the result of costly and persistent experimentation that extracts from a series of initial failures the knowledge needed to lay the foundation for eventual success. The Soviets did not achieve their nearest success without following this bitter road of educational failure. The first 11 attempts to launch a Soviet ICBM were abortive, and it is pretty well established now that Sputnik I was preceded by an unsuccessful satellite launch in mid-September.

If the American public is ever going to support an adequate space research program and a sufficiently aggressive weapons development pace, it must understand the hard facts of the situation. It must stop closing its wings of quick success produced with scientific legends about the Bell Boys game at the eleventh hour in the same manner that Mickey Mantle or Ted Williams swing a ninth inning home run to win the ball game.

And this brings us to the second lesson to be learned from Sputnik and Vanguard. This lesson is the simple but vastly misunderstood fact that you can't win scientific ball games with ninth inning home runs, but second field goals or 80 yard passes. Where we stand today in scientific achievement and weapons development is solely dependent upon what has been done during the yesterday of the past five to 10 years.

There has been a strong urge in top-level government circles also to gaze upon Sputnik to grab almost anything available of the scientific and hardware advances to make some kind of a spatial demonstration. Some utterly meaningless schemes have been seriously considered to make a "propaganda" comeback in space.

Even the Army's Jupiter C launched satellite now comes close to this category, although its function is its objectives. Their first casualty, proposed if you will when an "advance and back" would have been a second satellite in a space trail. A sphere of ice that would have a rapid trail through the sky; a dot spot on the moon hurtled there by a job of ICBM and research rocket action; a homestead Christmas sphere of inflated aluminum foil, and many other equally ridiculous proposals have been seriously crumbled over by the psychological warren in the National Security Council.

There is nothing to be gained and a great deal to be lost in time, money and scientific talent from these hastily improvised look-ups. The only way we can regain lost stature and achieve a continuously widening margin of superiority is to let the demonstration now lay a steady and continuous program of basic research, orderly but urgent development, and well planned, efficient production of new weapons systems.

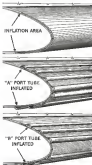
There is no lack of sound ideas on how such a program should be organized and implemented coming from the best brains of the aviation and scientific communities. But so far, there has been a lack of administrative skill and decision in the executive branch of the government to implement any of these ideas and proposals and really begin the vital move toward a sound, long-term research and development program. This program must not be used as stem-clubbing an adversary that is already off to a running start but passed to pass him in the critical years ahead and widen a significant margin of superiority for the future.

—Robert Hays

BFGoodrich



'Winterized' wings keep executive planes flying the year round



FLYING BUSINESSMEN can afford to be grounded. Delays due to icing conditions can mean a missing client, a canceled loan.

But B. F. Goodrich pneumatic De Ives executive delays—stable conditions to plus and complete repair they otherwise would have been able to. With B. F. Goodrich De Ives, air removal is a snap! Seal tubes inside the De Ives door inflator and deflator alternately to crack ice in its tracks (see drawings at left). The ice breaks off cleanly, washes away in the air stream. The operating cycle is completely automatic.

Now B. F. Goodrich De Ives on the wings of most multi-engine executive airplanes flying today. Businessmen know they can depend on them to cut right schedule—in any time of year—in any kind of weather. BFG De Ives are simply concerned on—without stretching or mechanical stress. As a result, they fly another, are easier to maintain and

have a much longer service life.

Installed in stream along the wings, the different sections operate alternately and automatically about the fuselage to ensure no disturbance of the airflow. The inflating sequence is controlled by either a centrally located distributor valve or by actuated-operated valves located in the wings adjacent to the De Ives air tubes.

BFG Goodrich De Ives can be ordered in original equipment on planes of the type shown above—the Beechcraft 370D, the Cessna 310 and the Aero Commander. Or they can be installed on your present planes by authorized B. F. Goodrich Aviation Products distributors.

For low cost post-season protection against ice, be sure to winterize your wings and engine with De Ives by B. F. Goodrich—owners of the pneumatic De Ives and besides in the field since 1928. Write today for free De Ives data sheet AD-340.

Types • Models • Breakers • Heated Rubber Boots • Inflatable seals • Fuel cells • Pressure Sealing Clippers • Kinetic Air Action Inflators • Nose and rubber accessories

BFGoodrich Aviation Products

a division of The B. F. Goodrich Company, Akron, Ohio

Consider these three important facts!

- 1** Kidde's continuous Strip Fire Detector, first of its kind on the market, has been proven successful by more than seven years of intensive flight experience on both military and commercial aircraft.
- 2** As a result, the majority of U.S. commercial transport manufacturers and air lines already using continuous strip fire detection have chosen the Kidde system.
- 3** Kidde's sensing element and adjustable control unit affords a wide range of settings through the greatest operating temperature range... a Kidde exclusive which makes the Kidde system not only ideal for percent-day aircraft but especially effective for aircraft now in the developmental stage.

Let Kalle's unrivalled experience in the field of aircraft fire detection help solve your safety problems. Write today for facts on the advantages of the Kalle system ... the continuous strip fire detector proven in flight!

Walter Kidde & Company, Inc.
Axtion Division

1218 Main Street, Belleville 9, N. J.

Dallas, Tex. — Dayton, Ohio — St. Louis, Mo.
Seattle, Wash. — San Diego, Calif. — Washington, D. C.

Walter Kilde Perillo, Van Rys, Goldstein
Market Buide & Company of Canada Ltd., Montreal

Wife W. Casco, board chairman, and Don S. Casco, president and general manager, Muscogee Blue Corp., Detroit, Mich.

Frederick D. Herbert, Jr., and Thomas B. Shewett, executive vice presidents, and Robert N. Brown, vice president and director of engineering, Kendall Company Inc., Little Falls, N. J.

J. L. Platt: executive vice president and general manager, Avco Aircraft Ltd., Toronto, Canada.

Elbert P. Kasper, president, Anacostia
Compliance Testing Co., Baltimore, MD
William McIlwain, vice president, Can
Inc., Therapeutic Corp., Glendale, Mass.

John J. Becker, vice president, International Business Machines Corp., New York, N. Y.

Marta Golomb will serve as director of Southwest Research Institute, San Antonio, Tex. Mr. Golomb is vice president at the institute.

At the 37th Annual Meeting of the American Rocket Society the following awards were made: Thos. F. Dunn, Civil and Mechanical Aeronautics for his rocket-propulsion engine; Rene Reth, Massachusetts Institute of Technology student, S1108 A8-3-Crystal Aeronautics for his paper on a new method of measuring the viscosity of hot gases; Fred-Cornell Merrill, S2-S-N, jet; Franklin Award for his rocket and jet-propulsion lectures; Kaffie A. Blomke, A8S Administrator Award, his paper on space flight; William H. Pickering, Yale University, for his application of rocket motors to the launching of a rocket; and Charles Levering Smith (S1-S-N); Ballistics Award for his work on solid propellant.

Asst. J. Tobin, curatorial director of the Port of New York Authority, has received the Order of the Legion of Honor from the government of France.

F. J. Adams, mortgage, Customer Service Dept., Corvus, division of General Dynamics Corp., San Diego, Calif.

Fred Speake, assistant director of marketing research and development, **Estel Me Culbourn, Inc.**, San Bruno, Calif.

Carl E. Anderson, manager of manufacturing, and Nicholas F. Fischlente, manager of sales and general affairs, Production

Walter E. Wolter succeeds Mr. Fischberg as manager of engineering.

Nancy Schechter, production manager, and Harvey O. Oberg, liquidation division manager, Wylin Laboratories, El Segundo, Calif.

► Air Force is still sitting on design requests from its warbirds fleet for:

► Air Force is still looking, as always, for more from the outside. There is a Japanese glide bomber with no ductors in prospect and only one test flight. Computing from an Bell Aircraft Corp., which produced the next jet in series with an B-101 project (AVC, Dec. 2, p. 28). North American, which is working a modified X-15 project with a million-pound thrust booster rocket. Republic Aviation, the Martin Co. and Boeing Airplane Co. Latest intelligence from Russia indicates the Soviets had tested an 80,000-lb. rocket engine for their T-44 hypersonic glide bomber, and the prototype weapon system is close to flight test stage.

* Navy is considering proposal for a "slow fighter," whose slow speed would permit a relatively large, stable platform capable of mounting heavy weapons, detection gear and a large number of long-range interceptor missiles. Chance Vought Aircraft and Hughes reportedly are working as a team on a long-range air-to-air missile that could be adapted to the project.

* **Cash programs:** orders sent to develop and produce valves especially made for hydraulic needle service. Various types of valves and actuators are supported by being the cause of 70% of the applications on both ECRM and ICRM being to date. New programs will result in initial expenditure of \$7,719,000 with new contracts involved. North American Analysis has three contracts under the valve program. Other firms, each with one contract, include Acropet General, Robertson-Fulton Controls Co and Wm. R. Whitaker Co. (A)

Lockheed Missiles and Space Division and Thielert have made good progress with development of Navy's Polaris solid-fueled test vehicle, under the contract, which, but Navy has not set aside final design of the nuclear-powered submarine capable to launch Polaris. Lag of the Polaris launching submarine is apt to be in far behind the operational status of the weapons, that Navy will have to push hard and rubber-band launching sites to use Polaris in the long gap until its submarines are in operation. Polaris test vehicle progress with Thielert rockets has reportedly been so successful that at least 50% of the scheduled test flights have been completed. Aerojet-General is providing contractors for the operational needs.

*Tires intercontinental belfite muscle transportation loading trials using a Douglas C-119 are being conducted at Lowry AFB, Denver, Colo. In loading tests belfite tires structural shell is mounted on fully air wheeling into hold of C-119. Same scheme is planned for Cessna Atlas ICRN. A program to modify the C-119 to carry the muscle is now under way (AW Dec 9, p. 26).

*Dassault Aviation Co.'s X-16 VTOL being developed under Army contract is now in the final assembly stage and scheduled for flight sometime next month. Aircraft is powered by Lycoming T-53; engine-to-propeller transmission has gone through a 50 hr. test; structure has been stress tested.

Strategic Air Command has established a facility on Twigg Ave., Calif., for training personnel for operational capability with ICBMs and IRBMs. SACs will frequently be required to rotate through the facility. SACs will be frequently occupied by Northrup-Dodge Controls Co.'s Western Research Laboratories. When available, this personnel training course personnel will be sent to Claude AFB, Calif., for field service training with Infrared sensors. Radar/Wavelength Corp. is entering SAC for its educational programs and in preparing various instruction manuals for the training course.

*Harvey Aluminum Corp., Torrance, Calif., is negotiating with Industrial Resources Division of the Air Materiel Command to build a rolling mill especially adapted for titanium alloys, with Harvey and Air Force each bearing half the machine's cost.

► Fact that latest firing of USAF-Thai intermediate-range ballistic missile fell short of target range is believed to have been caused by *propulsion malfunctions*. Initial guidance system, which received its first actual check-out in the firing, reportedly showed excellent performance.



Arco today

Crosley Height Finder has range, will travel

Mighty radar stations are the fixed listening posts of America's continental air defense system. But they are not enough. Troops on the move also need warning of approaching hostile aircraft.

A new radar was needed. It had to be light enough for easy transport, tough enough to withstand rugged conditions, yet powerful enough to scan heights beyond the reach of any devices previously available. The assignment of designing, building and installing it was given to Arco's Crosley Division. The M79-46 height finder is the result. Working in cooperation with the AEDC (Randolph, N.Y.) Air Development Center, Crosley has given the Air Force and Marine Corps facilities great reinforcement for national defense.

THIS IS ARCO

Arco today is a diversified organization whose products include aircraft power plants and structures, electronics for defense and industry, and specialized home and farm equipment. Arco's divisions and subsidiaries are:

Engineering—aircraft, marine and industrial power plants—Crosley—electronics systems and aircraft structures... American Kollsman—navigation equipment and related test products... Sea, Idea and East Flow—specialized farm equipment... Hoverset and Advanced Development—mobile and solid rocket motors... Crosley Broadcasting Corporation—the WLF radio and TV group... Moffett Limited (Hawthorne)—aeromedical gas and testing equipment.

Scientists interested in unusual opportunities for advancement can grow with Arco.

Arco makes things better for America

Arco

Arco Manufacturing Corporation
420 Lexington Avenue, New York, N. Y.

Washington Roundup

Education Effort

An original effort is under way to convert the National Security Council staff to the American people should know some of the facts of life if they are to properly support a genuine U. S. effort to maintain technological capability.

Attendance of Vice President Richard M. Nixon at a special dinner party, Washington last week, called for persons who are saying that the American people be given a frank appraisal of the situation given substance to reports that he hopes to shake the National Security Council and conservative members of the White House inner circle from their "finger in the eye" attitude. Party was held at the home of W. Bruce C. Foster (a vice president) of the Glaxo-Medison Chemical Corp. In addition to Nixon, guests included Paul H. Nitze, former chairman of the State Department's policy planning staff; Russell L. Colpitts, former USAF Under Secretary; Frank Shorrock, president of the Columbia Broadcasting System; publisher John Cowles and Lawrence S. Rieck, editor.

Nixon, who started preaching urgency while the White House guard still was referring to the Russian Sputnik as a "silly hawk," may be the man to push the issue of reform in the Security Council and even to the point of President Eisenhower. There are overtones suggesting this is part of his conflict with Sherman Adams, presidential aide who thinks the Soviets are only proving bullish in space.

Otherwise, Nixon professes that his big interest lies in the actual security aspects of meeting Soviet competition, particularly the possibility of using political and economic resources to win through in Asia and Africa.

Advisory Board's Potential

Among other Sputnik results may be increased recognition of the potential that could be realized from accepting advice from USAF's Scientific Advisory Board headed by James H. Doolittle. At a two-day meeting in Cleveland, Arco's group made a detailed study of the problem of limited war, basing down top experts in the military and scientific circles. In addition to the chiefs of staff, Central Intelligence Agency and Department of State representatives, defense top secret types at the meeting. The board also has named a committee headed by Dr. H. Clifford Shull, former USAF chief scientist to study the Air Research and Development Command and its related agencies and submit a program for improvement of USAF's scientific effort.

Vanguard Publicity

Rep. John Moss (D-Calif.), chairman of the House Information Subcommittee, wants to be a congressional lion with a defending Defense Department policy of providing advance information on just what was happening at Cape Canaveral prior to the elective Vanguard launching.

Sen. Richard Russell (D-Ga.), chairman of the Armed Services Committee, declared that it would have been better to have launched Vanguard in the middle of the night and then to have pointed to a satellite coming in the heavens, than to have had all the fanfare.

Calling for a blackout on satellite launching attempts.

Sen. Henry Jackson (D-Wash.), chairman of the Armed Forces Military Applications Subcommittee, said that Vanguard launch "doesn't really mean that we are as far behind the Russians as it might seem. But the publicity that will go out will be unfair to our clients." Moss, however, maintained:

"A fuller explanation of the real possibilities of success and failure should have been more strongly stated to the American people. Let us not let ourselves be lulled by the feeling that we are any more sophisticated by this test failure than we will continue to be until we clearly demonstrate our ability to match the performance of Russia's Sputniks."

"Before this next session we need more leaders. What are we doing? Failure or success, either, the rest of the world will not fight us with success until we put a satellite into space."

Missile Acceleration

Mr. Gen. R. A. Silvera, commander of USAF's Ballistic Missile Division, has drafted a program to accelerate the operational capability effort by 25%. Details, he says, are classified but it is evident that he recommends apply to the team to the Atlas and Titan intercontinental weapons. The program, Gen. Silvera says, has been recommended to the people's authorities. He did not say how much this will cost which probably is a factor the authorities will investigate.

Questionnaire to Industry

Senate Preparedness Subcommittee questionnaire to principal manufacturing companies engaged in the U. S. missile program (AYO Dec. 9, p. 24) plans have complete open records and development methods and economic methods. Among the questions:

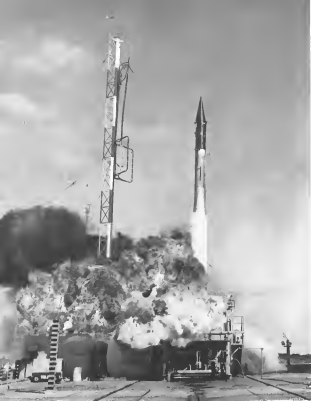
- How these items are finished, completed, in the Department of Defense as the cost of output?
- How research and development work been interrupted directly or indirectly by lack of funds?
- How research and development work been delayed by change orders?

CAB Investigation

Staff of the Special House Subcommittee on Legislative Oversight under the direction of Dr. Bernard Schwartz is moving forward with its investigation of the Civil Aeronautics Board and has requested Air Transport Act for comprehensive data on its dealings with the Board. The subcommittee wants ATA to reply.

All this and records, including but not limited to correspondence, inter office and other memoranda, reports, minutes of telephone or other verbal communications or other materials of ATA, concerning directly or indirectly, any correspondence, meeting, commission, conference, or other assembly, written, typed or recorded, be sent office, employee, representative, agent or other person acting on behalf of ATA with any number or employee of the CAB or any government official, regarding the CAB or any matters at on test before the CAB.

—Washington staff



WIND WHIPS the first stage engine fire which ended Project Vanguard's first attempt to place man-made satellites in orbit.



VANGUARD pre-launch checks are made at left and the rocket's first stage is mated by day as the same scene falls at right.



Defense Seeks Cause of Satellite Failure

Washington—Prime cause of the failure of Vanguard Test Vehicle 3 had not been discovered by late last week, and Defense Department indicated the reason will not be officially disclosed even if it is pinpointed.

Official statement was that the failure was caused "by a mechanical failure in the propulsion system, details of which are classified."

Vanguard officials said that recent the

trouble had been "isolated but not pinpointed."

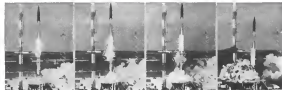
Neither Defense nor Navy would comment on reports that the fault lay in the fuel pressurization system. Vanguard's first stage engine uses helium to pressurize the kerosene and liquid oxygen propellants, and hydrogen peroxide to drive the turbine that powers the pressurized fuel pumps.

Launch attempt on Dec. 6 came after

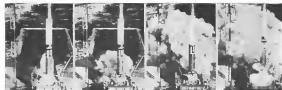
two days of delays caused by weather and major technical problems. Ignition was achieved at 11:45 A.M. and the TV-3 rocket rose high in four feet above its launching stand before thrust chamber pressure fell. TV-3 dropped backward onto the stand in flames, toppled over and broke in two.

One destroyed the first and second stages.

The third stage and the 4 lb., 6.4 in.



FIRST STAGE engine is burning maximum power (left). Cloud of steam in the lower right of the picture is produced in the rocket exhaust is mixed with water in the blast deflector field. In the second photo, the rocket nose shields as solid-fuel charges are set in place. The third photo and the rocket itself and burn fiercely in the last picture.



SEQUENCE taken from slightly above launching pad shows engine nose the rocket a few feet before the fire begins (right).

Soviet Predicts Failure Of Vanguard

Moscow-Soviet missile experts publicly questioned the "reliability" of the U.S. decision to rely on experience with Vanguard while not yet spent almost two weeks before the missile's failure at Cape Canaveral, Fla., earlier this month.

Shortly after their return from the CMCAC Rocket and Satellite Conference in Washington in early October (AWT, Dec. 7, p. 21), Soviet delegates to the meeting wrote in *Pravda* (Moscow) that the missile's failure at Cape Canaveral was "a disaster for the United States."

"The truth is that American scientists are experiencing difficulties with the rocket engine, which will not pass the stage of test stand trial."

The delegates told talks with American scientists showed that "American rocket technique is coming along well."

They added, however, that the American "Earth satellite program" was "the behind Soviet techniques," and "the growing power, which we in the Soviet Union have long seen necessary to still launching American satellites."

test missile were flown due to the fact that the satellite's bottom-mounted transmitter continued to "leak" the satellite was damaged too badly for further use.

Observers destroyed the third stage solid propellant engine. Damage to the launch stand was "moderately serious," Defense Department said. Launching tower and black house were not damaged and damage to the launch pad itself and the control room apparently were not severe. TV-3 launching was to have been the first flight test of the 7,500 lb thrust A-10 General liquid propellant engine as well as the first flight test of all three engines in one vehicle.

Vanguard officials have maintained throughout the test program that the first test satellite might or might not be put into orbit, depending on the degree of success of each step in the flight and that they considered the possibility of relaunching as secondary to keep all procedures of test work.

But the impact of Sputnik 1 and U.S. presence of more than 100 U.S. and foreign personnel in the Cape Canaveral, Fla., area and the fact that the partnership's attempt to reduce waste in formation meant that the failure of

TV-3 became more than an unfortunate attempt to launch a developmental rocket. It also included these:

- Vans, officials Russian news agency, abandoned its usual practice of writing unflattering and dispositive dispatches and got detailed notes of the failure to Moscow in briefing form.

- Newspapers here and abroad covered Vanguard officials' Defense Department and the Administration for oversteering "Vanguard" and "noted" public opinion regarding its "unique reaction that ranged from disappointment to bitter criticism."

- Defense Department, which had not held the firing as an attempt to launch the first satellite test satellite, found itself trapped in its own attempts to show more success. At least superficially it reacted by dumping down hard on release of anything but routine information to the Cape area and began to doubt whether TV-3 should be launched to prevent a public catastrophe.

- Russia reacted with threats and Communist Party chief Nikita Khrushchev and Sputnik 1's career rocket left off U.S. territory but the Americans will not give it up to us. U.S. claimed that as part of the rocket left in one U.S. territory.

Regulus II, Polarix Operational in 2 Years

By Russell Hovles

Edwards AFB, Calif.—Naval Chief Vought Regulus II hydro-aerospace cruise missile and Lockheed Fulcrum jet fighter missile are both expected to reach fleet status at the same time in next year, Rear Adm. John E. Clark, director of Navy's Guided Missile Division, announced here at the first public demonstration of Regulus II.

Admiral Clark and those are roles in modern warfare for both cruise and ballistic missiles, spanning Navy's long standing opposition to a doctrine based on one offensive weapon. He pointed out that while the ballistic missile undoubtedly has in its favor a margin of safety from enemy defenses, the cruise missile, with its variety of trajectories, is inherently not so easy to detect and an anti-ballistic missile is at least feasible.

Navy will eventually use its improved cruise air groups in response for "small wars," tested the against mobile on ballistic targets and against cruise missiles against their own bases. While cruise missiles are capable of delivering a conventional warhead over great distances, Clark said it is a very expensive way to do this. However, he pointed that as a limited but a steady role as Regulus with a conventional warhead will be used on targets so highly defended as to make attack by manned aircraft costly. He added that a cruise missile's use as a Regulus could be used for reconnaissance.

JTF Performance

Clark said that the General Electric JTF powered Regulus II has exceeded expectations in performance and reliability. Experts predicted that the recoverable and launching missile would average two flights before being destroyed. In practice they have averaged four and one missile has been successfully recovered on two.

Several submarines and surface vessels, including U.S.S. *Hyphant*, launched Regulus II. U.S.S. *Long Beach* launching at first time. Navy is being converted from the last up to recover missile Regulus II or Fulcrum. Conversion is practical but difficult.

The inability of the ship can be improved by adding the weight of missile and launch conversion above the ship's center of gravity. In a submarine, there is the additional problem of using not water under high pressure as in not to limit the depth at which the submarine can operate.

The nearest distance of a submarine is 15 ft. and that of a nuclear vessel is 18 ft. Clark expects the Navy's second replacement mode will be able to put



RECOVERABLE training and test model at Chief Vought Regulus II hydro-aerospace cruise missile. Not shown inside public 15 min demonstration flight recently at Edwards AFB, Calif. Missile, powered by GE JTF (12,000 lb thrust), reached 1,200 mph, 16,000 ft.

a number of ships originally designed to make cruise missiles more easily used, limiting the number of conversion vessels necessary.

Missile Storage

Hangar space will normally be required on both surface ships and submarines. In an emergency, Clark says any ship with the necessary power navigation system could be pressed into service as a missile carrier. In the case of submarines, this might mean an elevated hangar similar to the one being developed tanks used in the early Regulus I ship launching tests.

Several permanent hangar configurations are still being studied. Some of the problems about ship are cramped working spaces, handling of fuel and large parts, and preservation of space from one part of the ship to another. The last of environmental problems faced by shipboard storage is that from more experience and more difficult to design than the land-based base. Internal guidance can now place a missile within a few feet of a target 15,000 ft. away from the launching point under most gradual angles studies have brought the water's maps into register and more precisely determined the earth's shape. Because of drift of groundmass in the stable platform, some type of integrated motion offset is required.

The need for an exact system is more urgent in an aerodynamic cruise missile than in a ballistic missile because of the longer duration of guided flight in which error can develop. Several types of inertial units are still under development for Regulus II. Presently manufactured is a Doppler system and a

map matching technique with a radio-aided or passive radar map position fix, checked against an electronic overlay for position error.

Navy is making a passive, self-contained guidance system to avoid the effects of enemy electronic counter measures (AWN, Nov. 18, p. 34). The basic inertial guidance unit and the autopilot are the same as those used in Regulus I. This follows a policy set in the beginning of the project to use Regulus I components and make major changes possible.

Regulus II unit Mach number as a measure of altitude. It comes at most from continuous power with afterburner on and the signal from the outboard control altimeter, which for climb with the cruise level is needed. Service on a Regulus I is "over 60,000 ft." But in view of the performance of sustained climb which are also powered by the General Electric JTF, it is probably also over 70,000 ft. Maximum speed is said to be better than Mach 2, and in the normal dive no target is undeniably quite a bit better.

Missile Control

Recent missile test version consistently outran F3U chase planes. Still speed is about 225 ft. Landing speed and speed at burnout of the rocket booster are set at 350 ft. to give a margin of stability and control. Longitudinal control is provided by elevators on wing trailing edge only about six feet aft of the missile's center of gravity.

Small fixed hypersonic control surfaces forward and combined with a positive angle of incidence of perhaps 30 deg provide a longitudinal stabilizing moment to limit demands on the elevators.

control system. Chance Vought engineers report that aerodynamically, Regulus II is suitable in some respects for use in products as early as 1965, and is a possible path for high performance.

The jet-propelled missile is able to cope with the midcourse. The ramjet is not suitable. Maximum rate of turn is crucial in some stages per second. Wing loading appears to be well over 100 lb per sq ft. Good maneuverability is not needed for the mission.

The 12 ton missile is lifted off the launcher by a single solid propellant booster rocket built by Aerojet General. It is 20 ft long and 20 in. in diameter with the nozzle canted 17 deg. below the missile centerline to shoot the first stage through the missile's center of gravity. Thrust is 115,000 lb. Burn time takes four minutes. The 4-100 lb booster is separated from the missile by drag and gain.

Officers and men of Navy's Guided Missile Unit 75, the first operational unit scheduled to get Regulus II, are already working with Chance Vought experts at Dallas, Edwards and Naval Air Missile Test Center, Fort Meigs. Navy usually doesn't reveal details of guided missile units from general line and submarine forces other than from aviation units. For most of them the funding of the missile is a general matter, organized and they have other responsibilities in the ship or boat.

Officers must be qualified on land.

Programs for Future Sputniks Detailed by Russian Scientists

By Evett Clark

Washington—Scientists on Future Soviet Sputniks last week targeted a prediction that Sputnik V will be able to give radar and broadcast programs to a Russian satellite for an orbital science program that will meet other objectives in the ship or boat.

Working devices and wings will not be sufficient for earth and space power will be required. Professor Konstantin I. Sergeev wrote in the Communist newspaper Pravda.

Articles by Sergeev and other Soviet scientists were printed in a full-page article in the 1,000th revolution of Sputnik I. They included the statement by Academician Leonid Sedov, chairman of Russia's Commission on Interplanetary Communications, that Russia experienced no failures in its attempts to launch its first two satellites.

Rep. James T. Patterson (D., Conn.) told an American League Post conference in Middlebury, Conn., that the Russians at this very moment are calculating.

satellites. Despite the general absence of accurate background, the article has developed a respectable reputation for handling education, aerial regions and components during their years of experience with Regulus I.

The burning and test model of Regulus II demonstrated last week took place in the 100th revolution of Sputnik I. The test model was launched from the test range in an orbital region and is launched in a special sequence to measure center of gravity thrust.

A motor and gyroscopic ballast system serve the same purpose.

Radio command guidance, vector control systems and last minute variations in test program. Under control of a radio plane, the missile's control and the missile is loaded on a heavy adjustable tracking launch gun. A launch rail that is released by the closing of a circuit in the nose shock track only landing.

Length 77 ft, span is 10 ft with wings extended and 5 ft 4 in. with them folded. Folding vertical fins to direct control guidance, needed by 42 in. New tests with automatic load and release will be required.

The demonstration flight lasted 20 min. The missile reached an altitude of 50,000 ft and a speed of about 12,000 mph. Power was lost briefly but was regained without much loss of altitude. First flight of Regulus II took place May 1956.

Free Enterprise Satellite?

Polystyrene orbiting balloon, 14 ft in diameter, which could be inflated after being placed in a 150 mi high orbit by about 500,000 work of solid fuel rockets is being tested from some advertising agencies. A major source compare an oil company and a world wide leverage company among others have been selected for the possibility.

Turning the concentrated balloon would give data on variations in the Earth's magnetic field and the air density at the satellite's altitude. Time that the balloon remains inflated would be an indication of the rocket's trajectory.

For the concentrated aspect the balloon would be inflated and could have a few words written on it which would be visible in good weather with a pair of strong binoculars.

mission orbit at an altitude of 22,770 mi. Then it could be spent 5 hr apart in the orbit.

Length 77 ft, span is 10 ft with wings extended and 5 ft 4 in. with them folded. Folding vertical fins to direct control guidance, needed by 42 in. New tests with automatic load and release will be required.

The demonstration flight lasted 20 min. The missile reached an altitude of 50,000 ft and a speed of about 12,000 mph. Power was lost briefly but was regained without much loss of altitude. First flight of Regulus II took place May 1956.

Still another prediction, based on the translation of an article in a Russian commercial journal, is that Sputnik III will reduce current costs of satellites in order to save a glowing hot across the sky.



order to save a glowing hot across the sky.

France's contribution looked toward some collaboration and the carrying out of "cosmosphere space" but only after reduction of some problems.

Next steps, they said, are to send short-lived instruments Sputniks to altitudes of 475 to 500 mi for upper atmosphere studies, and to adapt means for recovering Sputniks to other test animals.

Sergeev, said wings and bodies will not be enough. The satellite will need power of its own and a small additional expenditure of fuel will be required for safe descent, he said.

Following that will come "orbital" satellites powered by solar energy and orbiting at great heights, to study design of cosmic radiation.

Next will come an extended part of the program—prolonged staying of animals at great heights and their recovery, to determine probable effects of cosmic radiation on man.

Man will follow—not in small satellites but in a permanent ribbon belt of fuel stages of cosmic rockets and other things between Earth and Moon. It would make use of solar energy to give food and would make use of the sun to create a state of gravity. Similar proposals have been made in the U. S.

"The present state of power development, plus the natural use of chemical fuels, particularly nuclear fuel, will enable us to accomplish all these tasks in the not so distant future, however

complicated this new seven year, Sergeev said.

Statistics between Earth and space stations and traveling from the station to the moon and planets would follow. Then would come a mission trip to the Moon probably from the station but possibly from Earth. Colonization of the future includes plans for living in caverns and creating an atomic power station, using lunar resources. The colony would become the first point for further exploration. Even so, the manned exploration stage will have been Earth said, Sergeev wrote.

USAF Space Efforts Outlined by Sessums

Los Angeles—Research and development of propulsion systems designed to better protect and sustain space travel efforts were reported here last week by Maj. Gen. J. W. Sessums, Jr., vice commander of the Air Research and Development Command.

At the Advanced Propulsion Symposium sponsored jointly by ARDC's Office of Space Research and North American Aviation's Rocket/Space Division, Gen. Sessums said that, while the Soviets are ahead with launching in space, they are not necessarily ahead in scientific conceptions above and beyond. He stressed that the U. S. needs more power investment tools to ensure development of the vital capabilities to control space.

During the current fiscal year, Gen. Sessums said that more than half of USAF's research and technical development funds are being directed into areas of study, research and development that will increase our capability for space flight. In the coming fiscal year, he said that percentage will be increased even more. The world.

In the propulsion area, we have an active program in high energy liquid fuels, and two solid fuel fuels. One of our research projects last month provided a new possibility for synthesis of high heat content fuels possessing a density reduction in cost. Although much work remains to be done, this has the marks of a breakthrough.

For about four years, the AFOSR has sponsored a comprehensive research program of liquid rocket combustion in the industry and the universities. We meet regularly on an informal basis to exchange information and discuss progress. The scope of the effort encompasses droplet behavior, reaction kinetics and most of the combustion phenomena which occur in the chamber of a rocket.

Some understanding has been gained of combustion velocities, heat transfer and the chemistry of reactions. This progress has more than paid for itself in terms of development time and dollars well. However, a matured effort is still required to gain the understanding necessary for predictable scaling of rockets and exploration into regions of ultra high temperatures.



Douglas Thor intermediate range ballistic missile is prepared for USAF design and engineering inspection at Douglas' Culver City, Calif., plant. New case is designed but when was this a significant development. Photo taken last week shows ball tank at extreme lower left (above), liquid oxygen tank at lower right. Balloon is shown in tank at left of middle row. Douglas plant is tested to produce up to 90 Thors per month, but a total of two by Douglas' Insulation. Operational use case with inspection without any must be completed by December to allow results program. Figure is a 165,000 lb. Thor. Rocketry is not.



FIRST photo of All American Engineering's tests with tailhook and arresting gear on USAF fighter. Engagement speed, 319 Mi.

F-84F Tests New USAF Arrestor System

By George L. Christen

New York—Prototype development of carrier-type arresting gear for modified USAF fighters has been completed and is now being tested by All American Engineering Co.

First photographs show trials being conducted with an F84F at the firm's test center at Santa Clara Airport, Cupertino, Cal. Pilot was David F. McGilchrist, chief, engineering flight test.

May Reduce Accidents

All American officials believe their fighter arrester system will allow such commands as Air Defense Command to their first arrester use by a non-seabird aircraft. They cite statistics which indicate that over 35% of all Air Force accidents are relative to stopping aircraft on the runway. Typical of the integrity of accident are wind-turbulence because emergency forces the pilot to land on a shorter than normal runway. Occurrence because of aborted take off, danger close or loss of fuel, landing on wet or icy runways, failure or misreading of runway because of fog blots.

All American engineers feel that most of all accidents due to these causes can be eliminated by use of the arresting hook in conjunction with an arresting engine such as the All American Engineering developed, under contract (ENR Sept. 2, p. 96).

Progress toward equipping USAF fighters with arresting gear was made recently when Air Defense Command's standard requirement for a lighter-weight arrester, including installation of tailhooks on its C-124s, was approved. The system was sent to the Director of Research

Office at USAF Headquarters, McClellan Field, Monterey, Calif. that a desirable feature of his company's arrester system is the low G effect imposed on the pilot during an arresting operation. He said that even at engaging speeds of 175-180 kt., deceleration forces the air exceed 1.7G. Low G is a result because programming the planes is equivalent to a 910 ft. runway. At lower engagement speeds of 100-130 kt., G forces are considerably lower according to McGilchrist.

All American's evaluation of the

fighter arrester system involved a series of 71 landings and engagements. Company reports that the effectiveness and reliability of the system was proved by the fact that once engagement touched in a safe, smooth stop. There were no failures or shorts.

Arresting hook is extended and retracted automatically by the pilot. All tests were made on a 5,800 ft. runway, runway using one hook-equipped F-84F and a smaller, equipped F-84C.

Although the runway arresting engine can receive for another engagement in as little as 17 sec. All American says that 10 sec. is a more realistic and practical stopping speed time.

Effect on Performance

McGilchrist says that All American made the hook installation on the F-84F with a weight penalty of 100 lb. The arresting hook assembly is supplied as a kit modification which can be installed by any USAF unit.

No loss of performance is experienced as the F-84F when the hook is installed in line of the central engine parachute according to McGilchrist. However, when it is installed in line with the drag parachute, a slight drop in high Mach (95 to 90) is experienced. Below Mach 90, performance loss is negligible, he says.

A single universal arresting gear to provide emergency stopping capability for all Air Force jets will now be possible because of the side disparity in aircraft weights—ranging from about 12,500 lb. to more than 45,000 lb. But 12 American jets, not two involving six engines, are involved, one for all. Lighter weight planes and another for all heavy jets including bombers, tankers and large transports.

Four new

MOTORS for MISSILES by EEMCO



EEMCO TYPE B01

Designed by EEMCO for missile applications where prolonged start is required under full load at a maximum speed of 1,100 R.P.M. to 4,000 R.P.M. SPECIFICATIONS: No. 27 with DC ON to 33 volt input. Maximum 12 ft. output max. shaft torque provided: 8.4 in.-lb. 10,000 R.P.M. 2.75 pounds. Motor Specifications: Fully rated 1000 rpm max. 10.4 in.-lb. torque. Maximum start requirement max. 10.4 in.-lb. torque. Motor is available in 1000 rpm and 2000 rpm. Features: Built for high shock and vibration loading.



EEMCO Type B02

Designed by EEMCO for extremely high altitude operations with maximum temperature capacity to 200° F. Type 11022 is capable of unusually high shock and vibration loading. SPECIFICATIONS: with 18 volts DC. Maximum 8.5 in.-lb. at 25% efficiency. R.P.M. 10,000. Fully rated Two-minute Ambient temperature 150° F. No start 16.75 seconds. Maximum Speed 10,000 R.P.M. Output max. shaft torque max. 10.4 in.-lb. torque. Features: Built for high shock and vibration loading.



EEMCO Type B03

Designed for missile applications where prolonged loading is necessary. Type B03 is a 1000 rpm motor with output power up to 1.25 HP. It is capable of withstanding vibration loads equivalent to 10 to 125 G's in a frequency spectrum of 30 to 100 cycles per second. SPECIFICATIONS: Motor: 24 with DC ON to 33 volt input. Maximum 12 ft. output max. shaft torque max. 10.4 in.-lb. torque. Maximum start requirement max. 10.4 in.-lb. torque. Features: Built for high shock and vibration loading.



EEMCO Type B04

Rated at 2.75 HP on continuous duty. EEMCO Type B04 is a 1000 rpm motor with output power up to 1.25 HP. It is capable of withstanding vibration loads equivalent to 10 to 125 G's in a frequency spectrum of 30 to 100 cycles per second. SPECIFICATIONS: Motor: 24 with DC ON to 33 volt input. Maximum 12 ft. output max. shaft torque max. 10.4 in.-lb. torque. Maximum start requirement max. 10.4 in.-lb. torque. Features: Built for high shock and vibration loading.

This company is invited.



ELECTRICAL ENGINEERING & MANUFACTURING CORP.

4372 West Ardmore Boulevard, Los Angeles 16, California—Telephone 834-0121

DESIGNERS AND PRODUCERS OF MOTORS, ROTARY AND LINEAR ACTUATORS... EXCLUSIVELY

B

eginning a dramatic new chapter in the story of CANADAIR

CANADAIR CL-44

Canada's impressive new
turbo-prop aircraft



The CL-44, the Royal Canadian Air Force's newest strategic transport aircraft, is now in full scale production in Canada. The CL-44 is available in commercial cargo and passenger versions for delivery in 1980.

Canadair invites inquiries Please contact Karl B. Lussien, Manager Commercial Aircraft Sales.

A proved Combination

The CL-44, both military and civil, is a developed version of the British "Belvedere". It offers some a triple combination: the efficient development of a thoroughly tested powerplant, the American standardization, and the efficiency-speed advantage of the turbo-prop engine. As a result, the CL-44 possesses to be a economical, flexible and practical transport for long and medium hauls.

World Wide Use Likely
Because the CL-44 is designed for future transport requirements, its development is being closely watched by many nations, bright future and no future.



CANADAIR

LIMITED, MONTREAL, CANADA

CANADAIR IS A SUBSIDIARY OF GENERAL DYNAMICS CORPORATION

• AIRCRAFT
• RESEARCH AND DEVELOPMENT
• GUIDED MISSILES
• NUCLEAR ENGINEERING

Reports Hint NATO Favors G.91 Over Four French Light Fighters

Flight test reports from the NATO lightweight fighter competition are reported to favor the Italian Fiat G.91 and one of the French entries. Then on the Dassault Etendard IV and VI (see cover), the Sud Avionics and the Regent Two.

While the competition ended the most likely outcome expected there was a recommendation to the various NATO member foreign ministries to consider one or more of the five entries (AW Oct. 28, p. 38). Usually, these were the most serious entries that the lightweight fighter would ever become a reality a serious production program (AW Sept. 10, p. 38).

Although Dr. von Kuman and then would undoubtedly be some last-minute push in the selection, he said the only official objection he had from the French was to the winning of some parts of the long test reports. This he stated as relatively minor.

Considerable emphasis followed the last reports that the Fiat airplane was favored. Among the reasons:

- Attempts by Fiat to sell the airplane to Germany entails the high delivery requirements forward. Not much hope is considered for this effort.
- Numerous cross-firing issues largely routine. Besides the Fiat-Brexit arrangement, Dassault also a significant with Fiat. Regent is tied to this.
- NATO committee which will make recommendation to NATO is an ad hoc committee. This means the committee is an ad hoc and not the usual of NATO or NATO's.
- Another interest in the airplane: Dr. von Kuman said an American pilot was allowed to fly the G.91 during the trials and Austria has been greatly interested in the airplane. This has no connection with the NATO competition.

Curtiss-Wright Asked For \$5.5 Million Rent

Washington—Curtiss-Wright Corp. is being asked for approximately \$5.5 million in rent on government-owned facilities at its Wood Ridge, N. J., plant, which the General Accounting Office charges the company has used for commercial production over the past seven years.

USA's Air Materiel Command and Curtiss-Wright have agreed upon a license before the Armed Services Board of Contract Appeals on Jan. 7. This date was Jan. 20, according to the Air Force.

Meanwhile, after the report on the claim against Curtiss-Wright by General Accounting, which was submitted to Congress on Nov. 27, Ray Edward Huber, (D-La.) chairman of the House Armed Services investigating Subcommittee, announced last week that a public hearing on the question would start in January on Jan. 7.

Curtiss-Wright challenged Huber's plan for a public congressional hearing during the time to settle this dispute is set for Jan. 7 before the Board, and Curtiss-Wright will then present its entire evidence in production of its refusal to pay what it claims is an exorbitant amount.

Any in part concerned furnished the plan by one holding a high position in the government, and the validity of the government's claim prior to the trial of the entire case is in effect to Curtiss-Wright and can only be paid in an effort to produce this evidence on the basis of the Board of Contract Appeals.

John Gorman, member of the subcommittee, said the General Accounting Office report was submitted to Congress Nov. 27 because at that time he was not in the Air Force to press the claim.

Speed Try Disqualified

Edwards AFB Calif.—First attempt to break world speed record in McDonnell F-300 Voodoo by USAF Maj. Adrian Dyer was disqualified due to a faulty timing system. A light bulb in the eye of the cockpit failed to blink as the plane streaked across from taking it as possible to identify the airplane. Federal Aeronautics International rules that when other pilots in the world have seen data of the original data.

Dyer's other run was made later in the week. Target speed was 1,200 mph, which is several times the one present announced on the former record set by the F-300. Speed of the first run was not officially measured at 1,100 mph, still fast enough to be a record if that had been accepted but less than target speed due to the fact that outside air temperature was 4.3C above standard.

Run were made along a 3.11 mi. east-west course at an altitude of 79,300 ft. Dyer put in 30 s. practice over the course before making the first attempt. His reported difficulty in taking altitude within the straight limits set in F-300 because of an unusually constant deflection on course was not of any real hindrance but is a factor of a second at such high speed.

He was using both hands on the stick during the final part of the run. Dyer was illiterate on the wing and stabilizer tips, and on the way he broke that occurred in the two runs. Skin temperature reached 110F.

Midway Traffic Jams Clog Entire System

Chicago's overburdened Midway flights volume that exceeds capacity; customers shy away from O'Hare.

By L. L. Doty

Chicago—Chicago Midway Airport, faced with the nation's heaviest air traffic is fighting a volume of traffic that often exceeds peak capacity during at least some hours of a 24-hour day.

Ranking first among all airports in the U.S. in the number of total annual aircraft operations, Midway is the source of traffic jams that can spread throughout entire urban centers in the form of flight delays and cancellations. The backlog often occurs in good weather as well as bad.

The crowded condition of Midway is an old problem in Chicago. Air traffic demand at the airport hit a new peak more than four years ago and now Midway has been battling serious traffic jams and bottlenecks ever since. Only immediate relief lies in a more extensive use of modern O'Hare field layout at the U.S. and as one of the two alternate takeoff or jet one paths.

But O'Hare, built to serve as Chicago's airport, never is allowed to operate and last year ranked 16th in the number of aircraft operations among U.S. airports. The anomalous situation is caused by the average passenger's reluctance to leave scheduled flights whenever it being scheduled through O'Hare because of its inconvenient location. Since airlines are reluctant to route flights from Midway because of past experiences in Kalamazoo, Illinois, where such a move in 1962 cost (AWN Nov. 25 p. 13).

Midway's Limitations

Under the best of circumstances, Midway can handle only 100 flights a day. The number of flights scheduled to and from Midway during at least some hours of a 24-hour day exceeds that period when U.S. airlines operate.

For example, between 4 P.M. and 5 P.M., a total of 46 aircraft movements is scheduled. At the peak at 4:30 p.m., the tower can handle no more than 10 flights. And this percentage is sustained only if no unusual interruption or control error takes place.

Limitations of the tower to cope with the volume of scheduled aircraft movements result in a lower degree of the entire period between 1 P.M. to 5 P.M. whenever weather conditions call for IFR operations. The bottleneck of

traffic is spaced tighter by an estimated 10 aircraft flights per hour working into Midway during daylight hours.

The same situation holds from 8 A.M. to 10 A.M. During the hour between 8 A.M. and 9 A.M., 61% of the scheduled aircraft movements are handled and, during the next hour, the tower can accommodate about 90% of the scheduled landings and takeoffs. For the balance of the morning, when scheduled movements are less than airport acceptance rate, but the backlog of flights in a holding pattern during the 8:10 A.M. period often takes traffic volume well above the scheduled rate.

Chain Reaction Delays

It is in this holding that causes a chain of traffic into the jet night hours when scheduled movements would normally be slack. But holding stacks are commonplace during bad weather or on after the 8 P.M. traffic has been eased and a delay of flight performance at Midway can result in a chain reaction of delays that spill over into the following day's operations from coast to coast.

Under VFR conditions, the tower can handle between 30 and 50 movements per hour when dual movements are not required. Most of the low U.S. airports operate with a dual movement configuration that takes the advantages of the dual system on when both when pilots of larger aircraft such as the Douglas DC-7 or Lockheed 1049 demand the use of the larger of the two runways and takeoff.

When dual runways are not used, airports are not to between 50 and 70 movements an hour. As a result, the 25 or so airports immediately between 5 P.M. and 7 P.M. can periodically drop to the peak acceptance rate which only one runway is used even under normal conditions will show similar.

During IFR conditions, the tower can handle no more than 40 movements per hour. However, the tower is forced to reject to take separation of aircraft because the tower equipment has been reduced to less than one hour, 30 movements an hour is considered the top figure.

Most operations near Midway, a "DC-3 airport." Its use was doubled immediately after World War II when

refined tracks bordering the north end of the field were used and runways were extended into an adjacent golf course. The improvement enabled Chicago to keep pace with annual air travel growth following the war but no further expansion designed to withstand congestion is a realistic possibility.

The airport is surrounded by characteristics that require glide slopes on the runways ranging from 1:1 to 20:1. As a result, field limits are 190 ft long and three-quarters mile visibility will above the usual standard of 200 ft and no half mile.

There is no dearth of runway. Few major airports can match the pattern of seven runways that should prevent any traffic flow from one direction and allow simultaneous takeoffs and landings. But the runways are short to modern vision aids and the field has lost one ILS and one runway is equipped with high intensity approach lights.

The longest runway—oriented on a northeast-southwest angle—is only 6,410 ft. in length. It is reinforced by a runway 3,845 ft. long. Three parallel runways angled at a northeast-southwest position are 3,900 ft., 4,557 ft. and 3,135 ft. in length respectively. This combination of runways is useful for two movements—each 4,717 ft. in length can move north-south the other 4,717 ft. can move north-south.

The City of Chicago has studied a number of possibilities for extending the runways but any increase will be at significant expense. The field is settled, isolated and surrounding areas that clutter the perimeter of the field. There is no chance that runways can be expanded to handle intermediate jet traffic.

Outdated Radar

The U.S. government is located at the southwest end of the 6,410 ft. runway at Midway. The radar provided to detect ILS approach is antiquated. However, other approaches to the runway are from the southeast in a traffic circle, limits are 190 ft and one and one-half miles out of the highest in the country for a major airport. Three instrumented aircraft in such a pattern leads to the minutes as compared with two minutes under normal IFR operations.

Midway was the last U.S. control tower to be equipped with radar. But the standard ASR-1 with two radar scopes is not equipped to take a circular polarization antenna so that two per operators have been transferred to meet

to ASR-1 antennas at time separation of aircraft.

Civil Aeronautics Administration plans to correct the radar problem this winter by replacing the ASR-1 with an ASR-1 radar equipped with circular polarization. ASR radar coupled with dual ILS equipment is a prime requirement of the CAA's six-year plan at all major U.S. airports.

Delays have caused only an insignificant number of flights to O'Hare and the gap left by those flights has increasingly been filled by additional services into Midway. Last year, the number of movements at O'Hare declined to 44,514 from a 1955 total of 72,120. Despite this annual loss, more flights at Midway have increased traffic at the state since 1955. That year, 131,800 movements were handled as compared with 172,800 in 1956.

O'Hare Advantages

O'Hare Field is designed in a pinwheel pattern with four runways intersecting at a central taxiway. Long of runways, opened in September, 1956, is 5,000 ft. long and can be extended to 17,000 ft. if necessary. A second runway, 7,435 ft. long and 150 ft. wide, is about 5,700 ft. long. Additional runways are planned by the City of Chicago.

Landings lanes are 200 ft. and one half mile. There are no obstructions on the field. The field is surrounded by glaze angles since the field is clear of obstructions. The field is surrounded by glaze angles since the field is clear of obstructions.

Although the field is surrounded by glaze angles since the field is clear of obstructions, it is superior to Midway, but passengers left against flights scheduled from O'Hare because of its greater landing distance from downtown Chicago.

Although the field is surrounded by glaze angles since the field is clear of obstructions, it is superior to Midway, but passengers left against flights scheduled from O'Hare because of its greater landing distance from downtown Chicago.

Target Date for New Throughfare to O'Hare in 1959

Surface transportation is the dead end factor in a passenger's choice of airport. According to Chicago airline officials, however, the Chicago airport for Midway is "psychological" since the time distance to either airport is exactly the same during any rush hour.

One Chicago airline official told Aviation Week that the Chicago airport is "psychological" since the time distance to either airport is exactly the same during any rush hour.

These hours the Chicago Loop is O'Hare for business service is one and one-half hours, and service is available from all urban areas on departure schedules better with airline schedules. Launching to Midway departures from the Loop every 10 minutes regardless of airline schedule, do not leave the airport from all urban areas and take one and one-half hours during the



CHICAGO Midway Airport, nation's busiest, for traffic attention past few years ago.

rush hour, one hour and fifteen minutes at other times.

The average geographical center of passenger destinations and origins at all airports on the southwest corner of the Loop which, psychologically, implies a shorter traveling time to Midway on the southwest side of the city than to O'Hare on the northeast side.

A total of 15% of Chicago passengers begin their trips with the Loop, 19% arrive at the airport by private automobile, 34% by taxi and 21% by bus. From here to Midway is less than that to O'Hare, but traffic conditions for the private automobile driver to either airport are about equally congested. Midway cannot be considered easily accessible by air standards.

Airlines Stick to Midway

The authority of passengers for O'Hare is largely responsible for airlines refusing to move a more substantial number of flights over to O'Hare. As a result, however, the Chicago airport for Midway is "psychological" since the time distance to either airport is exactly the same during any rush hour.

Only United Air Lines has established a service pattern at O'Hare which permits to ensure the airline a steady flow of profitable traffic independent of O'Hare. A number of regional airlines and all of the local service carriers fly to Midway because of the airport size of Midway's connecting traffic is handling facilities.

Many large carriers are equally unwilling to make the move. American Airlines, for example, operates all its Chicago-Los Angeles nonstop flights from the Loop every 10 minutes regardless of airline schedule, do not leave the airport from all urban areas and take one and one-half hours during the

rush hour, one hour and fifteen minutes at other times.

United Airlines has only one flight into O'Hare. Capital Airlines 45 flights into Midway from the east and added six into local flights to O'Hare.

Norfolk and Eastern Airlines serve Midway with all their flights. Trans Canada Airlines serves only Midway. TWA operates 24 non-stop flights from Midway but only one flight to Wichita and one non-stop route flight to Los Angeles are scheduled out of O'Hare. Whether the Chicago problem will be solved within the near future is in the hands of scheduled airlines, the City of Chicago and the CAA.

The city is waiting for the results of studies recently conducted by the CAA Technical Development Center in its attempts to determine the best site for the new runway at O'Hare. It also is moving ahead with the improvement of one throughfare—Congress Street—in order to improve airport operations at O'Hare. However, a completed highway direct to the airport does not appear likely for several years.

The Civil Aeronautics Administration is required to maintain to continue to accept the traffic demands imposed upon it until the volume exceeds present capacity. The CAA considers hazardous at present, the overcrowded conditions are being handled by controls with a competence which one airline official has termed "bushy" despite a controller experience level of approximately 45%. Another airline executive described the Chicago tower as "one of the most efficient in the country."

Many airlines officials reduce the necessity of scheduling Midway's congestion by transferring flights to O'Hare. But the

New Titanium alloys

*developed by Mallory-Sharon
for the missile*

Two remarkable titanium alloys developed by Mallory-Sharon's Research Laboratory further extend the usefulness of the metal in hot environments. This development promises more and more applications in rockets and missiles for titanium—strongest metal per pound of weight in its temperature range.

Commercial introduction of these new alloys anticipates research and development over a two-year period. In the intensive evaluation of both laboratory and production ingots, thousands of individual tests were made and analyzed. The results:

The first new alloy (MSF 801) is a weldable sheet and bar material which offers strength equivalent to regular titanium alloys—at temperatures less than 1400 degrees F. This exceptional advantage is combined in the range of 400 to 1000 degrees F.

The second new alloy (MSF 254-16V) offers remarkable ease of fabrication for a high strength material. Sheet metal parts can be readily formed while the alloy is relatively soft, then can be heat-treated to high strength. Heat treatment more than triples the strength level of this alloy.

As titanium's future in our air defense grows, it is likewise proving its economic advantage in new industrial applications. Let Mallory-Sharon, technical leader in titanium, help you design ahead with this new metal.

MALLORY  SHARON
MALLORY-SHARON TITANIUM CORPORATION • RILEY, MISSOURI

 Producers of titanium and titanium alloy sheet, strip, plate, rod, bar, billets



KAI TAK's new runway runs under construction (center of picture), points southeast into Lamma Pass. At left is present airport with two runways, one parallel to the new one. At extreme right, part of 1,200-ft. Mt. Tei is visible. Two runways have crumbled into Mt. Barker with land reclaims, one in 1949 and one in 1953. In background are 1944 high apartment buildings, some to be used as airport improvement purposes. Between buildings and new runway is section of Kowloon Hills foothills, already leveled 150 ft. for dense approach from southeast.

Hong Kong Improves Airport Approaches

Hong Kong—Half-enclosed Kai Tak Airport, site of four major commercial airlines, is being improved for the jet age under its \$16.1 million program. Work includes building a new runway into the harbor, leveling of hills and other approach obstructions, installation of modern landing aids and construction of new terminal and passenger facilities.

The present airport has been the subject of criticism for some time. The modified Hong Kong Guide calls it one of the worst in the world. A government public relations booklet describes it as "one of Hong Kong's biggest headaches... seriously in arrears." This column's test pilot as part has been called a supreme test of courage. As an American airline pilot put it: "There's just no room for error. If you're wrong, you're dead wrong."

The time-shedding hills and broken spots that make Hong Kong a bad natural harbor also pocket Kai Tak. An airport and airline companies to use this short Japanese-built runway nationwide difficult. The approach gradient is roughly 1 in 15. The three parallel, landward runways for clearing 1,500 ft. wide Lamma Pass with hills 1,500 ft. high to port and 500 ft. high to starboard on bearing 31, making a 60-deg. turn over 150-ft. high Kowloon Hills before landing on bearing 13, or raising a ploop into the

approach buildings on bearing 10 and bearing 07.

Volcano, are limited to curves 25 or 11 which again calls for a 60 deg. climbing turn.

Both runways are dead-end. Presently, mostly, winds build up clouds and fog, both which make for poor visibility, particularly from China to Mt.

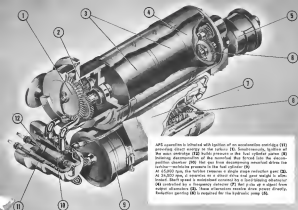
The airport closes at night, with weather minimums set at 2 in vis, 100 ft. and 500 ft. cloud base.

Civil Aviation Director M. J. Munnell-Walsham claims that Kai Tak has the "most safe, record in the world" is questionable. Between December, 1948 and April, 1951, four major commercial transport airlines had, in virtually the related spot on Mt. Barker, part side of the Lamma Pass approach—nearly 100 lives. Serious school and accident accounted for 22 lives in 1948-1951, and 187,966 passengers through Kai Tak in 1950.

To eliminate hazards, to increase toward revenue and to insure that Hong Kong will retain its place in the coming commercial jet age, as the final point of an route in the Western Pacific, the government has set in January, 1955, the first \$16.125 million stage of what will ultimately be the largest single civil engineering contract in its history. Result is expected to be

an 8,142 by 200 ft. runway with parallel taxiway stretching into Kowloon Harbor and a modern airport capable of taking the largest jet aircraft in use. The new runway is scheduled to be in operation by August, 1958. Then in steps from the terminal, maintenance and administration areas will be constructed on the site of the current runway and should be in operation a year later.

The psychological effect on pilots is expected to be considerable. New approach gradients will be 1 in 40 for the straight southeast approach over the Kowloon mainland and 1 in 50 for the straight southeast approach over Lamma Pass and Kowloon. Landing from the northwest, pilots will be able to fly down to 100 ft. over the sea and make a direct approach toward runway, only a 40 deg. turn into a 1,000-ft. straight approach to the touchdown threshold. Contrasting the curve (5,000 ft. radius) is designed to conform to a rule 1 turn of an aircraft flying at 160 kt. Landings from the southeast over Lamma will be standard ICAD instrument-approach forced. Presently, four installed air navigation surveillance aids for aircraft separation at 100 kt. range and visual descent, and OCA minimum-range surveillance and precision-approach radar will be used from 50 kt. Beacon lights will provide for local



APR operates in tandem with ignition of an instantaneous cartridge (10) providing direct energy to the turbine (12). Simultaneously, ignition of the main cartridge (12) builds pressure in the fuel cylinder (30) insuring decomposition of the material that forced into the decomposition chamber (20). The gas from decomposing material drives the turbine-mechanism pressure in the fuel cylinder (30). At 4,500 rpm, the turbine becomes a single stage induction pump (30). At 24,000 rpm, it becomes an electric motor that generates a self-excited generator. Self-excitation is maintained constant by a self-regulating detector (44) controlled by a frequency divider (27) that picks up a signal from output alternator (38). These alternators receive drive power directly. Redundant gearing (10) is required for the hydraulic pump (36).

THIS CUTAWAY SHOWS HOW . . .

Design Simplicity of Missile Accessory Power System Contributes to Light Weight and High Reliability

Completely self contained, General Electric's new accessory power system furnishes steady-state electrical characteristics, reduced complexity, simplified operation, and a high degree of reliability.

FOOTSTRAP FUEL DELIVERY induces gas-turbine weight and complexity by eliminating need for fuel pumps, pressurized air or nitrogen bottles, and fuel nozzles respectively. Within the fuel storage cylinder, a strain gage sensor prevents the material to provide a constant flow to the decomposition chamber.

TORQUE MODULATION, accomplished by a load bearing alternator circuit compensates for changes in load demands, determines valve regulation of fuel or fuel gas flow—offers precisely controlled speed.

The model illustrated—rated at 4.5 kw, 2150 psi hydraulic power, 3 kw of 115 v ac, 1 kw of 280 v ac aircraft dc power—provides frequency control within ± 1 percent and voltage control within ± 5 percent without size added weight of a regulator.

DESIGN FLEXIBILITY, highlighted by an easily modified fuel pump and a new port arrangement of newly introduced hydraulic and electric components, permits ready adaptability to a wide range of outputs and duty cycles—maximum size, weight, and complexity of reduction gains.

For more information on how this multi-unit system can fit your application, send the coupon at right or contact your General Electric Aviation and Defense Distributor Sales Office.

Developed by General Electric's Aircraft Auxiliary Turbine Department, 2410, Massachusetts.

Progress is Our Most Important Product

GENERAL ELECTRIC



Thirteen inches long, five inches high, five inches wide, thirty pounds including fuel, APR makes rapid output in one-half second.

General Electric Company
Division E211-18
Tosconville, N. Y.

Please send me literature GEA-A72 containing detailed information on General Electric Auxiliary Power Systems.
(Please include project) ☐ Reference only

NAME _____
FIRM _____
COMPANY _____
CITY _____ STATE _____ ZIP _____

Old, New Airports Compared

PRESENT KAI TAK	Gross Weight	NEW KAI TAK
115,000 lb. with conventional load on gpm	400,000 lb. of any type aircraft now projected	
Boeing 747, DC-10, Conquesters, L-749	Boeing 747, Douglas DC-10	
Daylight only	Operational 24 hr.	
2 no. vehicles, 500 ft. closed line	Possible better due to improved up pushers, airport lighting, radio aids	
15 to 20 aircraft movements per hour	Estimated 32 aircraft movements per hour	
Estimated about 50 million and 100,000 passengers annually	Expected to be about 510 million and 60,000 passengers by 1990	

area from the Lagoon approach at 100 ft. maximum altitude with highest ground in the vicinity being only 400 ft. Below it is the western runway approach in fact at 500 ft. maximum over the airport area.

In joining the Kowloon Hills by 150 ft. the 2,554,000 cu ft. excavated air being used in fill on the higher levels of the reclamation. New apartments will have to be built to compensate the green for the scheduled raising of three newly-constructed 10-story apartment buildings which sit 250 ft. into the park of approaching aircraft. In fact, the 10th Street Hill of the Sanhedrin, and low back road, stand and at the proposed new urban construction but fast to remove a 10-story block from the center of the 100 ft. hill and set it up in an equidistant built gain, in geographic, the removal of 70 Ping, lost King of the Song dynasty.

Engineers report that the reclamation of work 165 acres the dredging of about 50 million cu yd. and the construction of some 5,400 cu yd. of soil and concrete for the runway and parallel taxiway was closed up by the unexpected appearance of highly acidic soil. For the job, two bullet-shaped water tanks to Hong Kong from the north of France. Aircraft design depth was about 14 ft. below Principal Station. Low water spring tide had reached a maximum of 10 ft. The runway, when completed, will provide 7,300 ft. for curved landings from the southwest, 3,800 ft. for straight landings from the southwest and the full 13,400 ft. for takeoffs in either direction.

At least flights through Hong Kong are expected to use Kai Tak for short haul flights. Institute upon plans call for an area of 150 deg. turn from 115 aircraft of air and air carrier use of through flights for eight planes. Twenty years have been set aside for buildings, air ports, etc., in the second area.

Deferred Freight Rates Proposed by Examiner

Washington—Continuation of cost-cutting for deferred freight for air cargo rates has been recommended by Civil Aeronautics Board examiner Herbert B. Brown.

During numerous tests authorized by deferred freight, meaning that cargo rates for deferred freight will be deferred freight meaning in all other instances, it is 55% of the regular freight rate. The examiner also recommended that:

• Permitted existing deferred freight rates on shipments under 2,000 lb. and thus, full rates on shipments of 2,000 lb. or more, be continued.

• Carriers should be authorized to provide continuation regular and deferred freight service subject to the condition that the shippers be advised that the shipment does not become deferred freight service until it arrives at the point where it actually enters such service. The applicant would then either the service, or a spare available from the two, of which would be compared from the time it enters the service.

• Carriers should permit shippers to

compare to whether freight from deferred freight service upon the payment of the deferred freight rate between deferred and regular freight plus a premium to cover the increased cost of handling.

• Carriers should not be required to give notice of an unusual delay in the movement of a deferred freight shipment.

The CAB, in April 1976, authorized deferred freight rates for an experimental period of one year. The cost-cutting program was held to determine if the rates should be extended and what modifications should be made to the original order of air.

Slick Asks to Suspend Some Cargo Service

Washington—Shin Airway has asked to suspend all cargo air freight service between San Jose, Costa Rica, Quito, Ecuador, Dallas-Fort Worth, San Antonio and Houston beginning next Monday.

D. W. Russell Slick Airway board chairman is asking regulatory authorities and unaffiliated airlines based on the cargo line to ask the Civil Aeronautics Board for permission to suspend the service between those points. He added the suspension would be of a temporary nature until the airline can obtain new aircraft which would be much more economical to operate.

Slick cannot continue to operate the scheduled service from these points until the unaffiliated airlines and the airline can obtain new aircraft which would be much more economical to operate. Slick's new line of aircraft, which ships of the DC-6 type that are larger and cost less per mile to operate, is scheduled for delivery late next year. As this time, Slick and his larger service can be sustained.

Restarted and service to other points on Slick's cost-cutting program will not be affected. This includes service to San Jose, Houston, New York, Los Angeles, Chicago, Cleveland, Indianapolis, Chicago, Philadelphia, Wichita, Los Angeles, San Francisco, Baltimore and San Diego.

Aircraft May Begin Service To London With Tu-104

London—Worthington the Russian state airline may begin service on the L-500, which will be used on the L-500 route with the Tu-104 jet.

The two Soviet jet, last week, in Moscow, Zhelezovsk, head of Aeroflot who arrived in London to discuss possible extension of such a route with British authorities.

He suggested that turbo-prop aircraft such as the Ilyushin 12 or Antonov 12 also might be used on the route.



The X-17 is built by Lockheed's MISSILE SYSTEMS DIVISION—now engaged in advanced research-and-development projects involving missiles, rockets, electronics, nuclear propulsion and other space technologies.

FOR ALMOST TWO YEARS THE USAF/LOCKHEED X-17 MISSILE HAS BEEN GATHERING DATA ON THE RE-ENTRY OF BALLISTIC MISSILES INTO THE EARTH'S ATMOSPHERE. DURING THESE REPEATED TEST FIRINGS THE X-17 ESTABLISHED THE IMPRESSIVE RELIABILITY RECORD OF HAVING FLOWN SUCCESSFULLY IN 92% OF ALL LAUNCHES.

LOCKHEED means leadership

RESAULTS: MISSILE & DEVELOPMENT • PROTECT • REACTION SYSTEMS MANAGEMENT • ROCKET POWERED FLIGHT • ADVANCED ELECTRONICS • AIRCRAFT-BASED
INTELLIGENCE • LONG RANGE BATTLE FARMING SALON CONSULTANTS • JET FIGHTERS • JET FIGHTERS • CONFIDENTIAL & MILITARY PROGRAMS • LINTAR LINTAR



MANNED SPACE FLIGHT will probably begin in a so-called hypersonic glider similar to vehicle A shown in a nonlifting, unaided spherical craft somewhat like the three to the right according to aerospace experts. The glider would be the most versatile medium as it could sustain altitude and change direction upon re-entry to effect a landing of war point on the earth. The nonlifting vehicles would plunge to the ground as soon as drag reduces their velocity and re-boosted lift before the solidly supported A. A completely spherical vehicle has been proposed by Kaulf Etkin as a space probe to allow men to return to the earth from double space station gliders, etc. Vehicle D at right has fins added to

stabilize the sphere and a small rocket motor to slow it to re-entry speed. The hemispherical vehicle B was suggested by A. J. Eggen Jr. of the NACA as entering the atmosphere like a manned re-entry craft. Vehicle C has been described by a number of scientists. The purpose of the truncated cone on the left portion of the sphere is to make the vehicle slightly unstable so that it will wobble as it enters the atmosphere. The reposition point on the hemispherical body, which is heated to the highest temperature during re-entry then becomes a rather large circle spreading the heat and lowering the maximum temperature on the vehicle.

Sphere, Glider Feasible for Re-Entry

By J. S. Rutz, Jr.

New York—Scientists of U. S. space flight efforts for years to come now depend on the choice of a vehicle to win the second stage in the struggle to control space, members of the American Rocket Society said last week.

Goal of this second round placing a man on orbit around the earth and bringing him back safely to the ground, has been under scientific and propaganda value for the nation reaching its first regardless of the manner in which it is accomplished. Its greatest significance, according to many U. S. scientists, will be to demonstrate how well the government is living the government for human space activity. The government's management decisions will be to choose either one or both of two feasible vehicles which can be propelled by large rockets into orbit close to the earth and then return as fast as they can.

Winged hypersonic gliders first can ascend the atmosphere and use its lift to return in the upper air and slow down before it returns to the surface.

Spherical or modified spherical vehicles which develop as lift but can catch, plunge, back into the atmosphere from space if its flight path is correct. The spherical craft would take a much longer time to develop than the hypersonic glider—two to two years against five for the glider. It is the most representative vehicle—said the U. S. in a letter printed to send the first man into space.

Priority Performance

Yet many international and aerospace experts who are very anxious to repeat the cheap U. S. prestige has suffered in the last two months feel that spherical craft should have second priority and that nothing should interfere with the development of the hypersonic glider. In their opinion the spherical, non-lifting craft would be a stopgap measure if developed alone and should occupy only a small part of our total development capacity.

This opinion arises from the belief that the hypersonic glider is at least three times as fast as a total part of an large scale movement into space and that the sphere will never be more than a space

probe to bring men back from disabled gliders and space stations. The glider will be safer and more controllable than the nonlifting craft and it will be able to land in one place location on the earth's surface.

The sphere, however, glider will be as valuable as another was, which is fully as important in the space aspect. It will require that great effort be made to answer the aerodynamic problem of winged vehicles (heating, stability, control, drag etc.) up to about 25,000 mph. Hypersonic, low-boom, light, rocket transport planes, etc., will all be more possible as soon as these problems are solved.

As for force that has sole possession of such craft would border on the impossible, hence the scientific opinion that the hypersonic glider should receive a maximum engineering effort.

Another thrust of scientific thought regarding placing a man in space is the doubt that large rocket vehicles will be suitable enough within the next few years to transport humans beings. The odds involved in so-called the atmosphere in a spherical capsule plus the dangers of using rockets into space



would give men small prospect of a successful journey for several years to come in the opinion of many scientists. Pressure to send the first man into space at all costs and help the U. S. on the propaganda front could force governmental action to attempting to develop a hypersonic glider in the shortest possible time. If this occurs, about the year 1970, the second round then becomes not so much a question of whether the U. S. can develop large rockets and a re-entry sphere before the Russians, but rather will the U. S. program be deemed to having secured the Russian again because the U. S. demands too much reliability from its system.

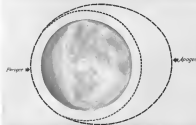
Russian officials might consider giving a given lift to their space flight vehicles at a much earlier period in a development program than can be realized until their own site space to a man on the U. S. would judge results. This almost unattainable limit, of course, affects the outcome of many of the technological goals we are in with the Russians.

Two Best Choices

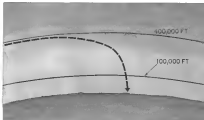
Regardless of the policy decision at the last space flight program, great scientific opinion holds that either the hypersonic glider or the spherical vehicle will carry the first man into space and bring him back.

Several types of nonlifting, orbital and re-entry vehicles of general opinion and of design have been proposed over the last few years. Kaulf Etkin of Columbia and several scientists of the National Advisory Committee for Aeronautics including A. J. Eggen Jr., as among those who have written on the subject. Such vehicles would be similar

MISSILE ENGINEERING



CHANCES ARE HIGH that a manned satellite would enter an elliptical orbit rather than a circular orbit as it is sent into space. Theory shows that a nonlifting vehicle must enter its re-entry at a very low angle and at such a gentle velocity to keep deceleration and temperatures below the critical point. The elliptical orbit would eventually decay into the necessary circular path as a guidance decelerates. Since this might take months, a manned satellite would be supplied with rotating rockets to fire as it passed over and through the perigee. This would shorten the time needed to enter the circular orbit and require a minimum of guidance and propulsion weight.



FINAL PHASE of the nonlifting satellite's return to Earth is a re-entry phase during which deceleration will not exceed 7Gs if the plunge begins at the proper re-entry velocity and at a low angle to the horizontal. Greater velocity required to enter increases as the satellite moves toward the Earth, the vehicle's nose is furnished to the potential energy released at altitude is lost. Once atmospheric drag decelerates the sphere into the potential energy is released, the plunge begins. The more lightly loaded spheres will start their plunge at the higher altitudes and experience a lower deceleration and temperature as they fall back to Earth. At approximately 30,000 ft a parachute would be deployed to lower the sphere safely to the ground.



94,000 ROUND TRIPS TO THE MOON!

48 billion miles! That's the distance logged last year by passengers aboard airlines throughout the world. This figure represents a 14% increase over airline passenger mileage in 1965. And the record for 1967 is expected to be even more impressive.

As the world's air traffic grows, so does the demand for new and better planes — and for

new and better products to power and lubricate them! Esso Mobilene continues to lead the way in providing the world's thriving air travel industry with superior service — and with superior aviation petroleum products, backed by 84 years of Esso research.



8 OUT OF 10 OF ALL INTERNATIONAL AIRLINES USE

accomplish this, the fuel system engineers must allow for sloshing to keep the propellant mixture correct for great accuracy.

Rocket Fuel System

When highly reactive fuels are involved, attention must be paid to safety for combustion stabilization of the products of these fuels is to be realized, according to Warren Koller and Gilbert S. Jukla, Marquardt Aircraft Co., Van Nuys, Calif.

Speaking generally of rocket burners, the authors said that stratified fuel distribution would cause slight reduction in combustion efficiency even when there were no leak problems as flameholding, depending on rate, too little.

Assuming that they could use a fuel so reactive as to eliminate the need for flameholders, the authors looked forward to a simple fuel system which would use hypersonic fuel which would ignite spontaneously as it came out of downstream-directed orifices. They said that stratified combustion chamber pressures at high altitudes make the use of these more active fuels attractive, while the increased combustion inlet temperatures at Mach 4 and above help by making ordinary fuels more reactive.

Solid Propellant Pusher

If solid propellants could be used as substitutes for most gas and turbo-pumps, lighter, more reliable liquid rockets might result. Jerome Holmes of the Solid Propellant Division, Reaction Motors Inc., pointed out that solid propellants such as Imperial Chemical Industries Ltd.'s ammonium nitrate solid propellants, which are ammonium dichromate in a solvent, be used in either propellant tanks directly and push the propellant into the rocket throat chamber.

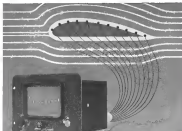
Underbrush, though this solid propellant does not form combustionable reactions with the liquid propellants, it produces 85% solid products which can act as erosion media for distribution in most propellant tanks. Also, the most solid systems, in having the same solids with temperature, producing serious permeation in operational use.

Required Properties

Need a low loss combustion temperature, solid permeation propellant whose combustion products contain no solid particles and do not react with main propellants.

In addition to his company, Reaction Motors Inc., Schenck and the U. S. Naval Ordnance Test Station and M. W. Kellogg Co. have been working to develop this concept of using solid fuels.

SEE and MEASURE pressure distribution



with CENTURY
Model 20
VISUAL MONITOR

Visual presentation of airfoil pressure distribution is achieved by a major airplane manufacturer by means of the Century Model 20 Dynamic Visual Monitor.

By dynamic line-graph display, simultaneous observation of 24 pressure-transmitted signals is permitted throughout the extended range of frequencies. Variations in pressure gradient, peak pressures, as well as oscillations associated with sonic flow phenomena are thus presented in continuous scaling form.

Information presented by the Monitor permits a high degree of selection of these data for permanent recording by conventional tape or recording oscillography process. With such direction available, the great savings in data reduction time becomes apparent.

The Monitor provides a display of the focused light beam from as many as 24 pen-type galvanometers on a calibrated viewing screen, 24" high x 40" wide. Galvanometers, flat in range of 0 to 42 gpn with sufficient deflection sensitivity for direct coupling to most transducers are available. Other galvanometers are available for use in the region of 0 to 240 gpn.

Monitoring of temperature throughout a system as along a given piece of material, monitoring of vibration, flow, collimation and current are also vital applications of the Monitor.

Century Electronics & Instruments, Inc.

1233 No. Union Turn. Oldale, Ill.



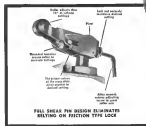
HERMETICALLY SEALED,
LIMIT SWITCH

WITH **STEPLESS
ADJUSTMENT**

OF ROLLER ARM ACTUATOR



Rolls interdependently when
adjustment is re-
quired in future.
Model 10-25-050L, 2 COV,
intermediate with
K2504-2
Model 10-25-050L, 2 COV,
intermediate with
K2504-2



FULL SHEAR PIN DESIGN ELIMINATES
BELTING ON FINGER TYPE LOGS

NOW YOU CAN get stepless actuator-arm adjustment in a light weight, hermetically-sealed switch for control of landing gear movement, bomb bay doors, turret and other aircraft components where dependable, environment-free switching is essential. The Electro-Snap HI Series provides greater-application flexibility with infinite actuator adjustment through 14 degrees. Easy to install.

Electrically and mechanically, the HI Series has a minimum of 200,000 cycles. Electro-Snap construction permanently seals dry, inert gas inside the rugged case to assure positive performance with full electrical rating up to 100,000 ft. altitude. Highly resistant to adverse environment.

For full specifications, WRITE FOR DATA
SHEET HI-43

**ELECTRO-SNAP
SWITCH & MFG. CO.**

1225 West Lake Street • Chicago 24, Illinois

CHARACTERISTICS

Circuit arrangements	NO-25-050L, 4 throw NO-43-050L
Rated	100V-631 watt fully closed
Maximum differential	645-025 watt fully closed — 500
Operational	950 min
Operating force	4 lbs ± 3/4
Overload force	11 lbs ± 3
Withstand strength	1000 V R.M.S. min
Ambient temperature range	-100° to +120° F.
Min. mechanical cycles	100,000
Electrical rating	10 amps @ 115/120 V a-c 18 V d-c ind.
Difference of opening and rear point between each pole	512 max
Weight	8 oz max

MODERN DESIGN IN A COMPLETE LINE OF SWITCHES



TV Camera Receivers Check Rocket Engines

Laps closed cockpit television system for guided missile engine has been installed by Hallam, Electronics Corporation of the Sigbee Corp., at Aerojet General Corp.'s rocket engine test facilities in Azusa, Calif.

Three tv cameras, camera-control "chassis" equipment, Hallam's Azusa Aerojet General is using these cameras in both its liquid propellant plant and solid propellant plant.

Hallam is currently installing a similar system of 24 closed-circuit television cameras for the Martin Co. general contractor on three suborbital ballistic missile programs at Martin's Denver plant.

A 25-hour system is currently installed by Hallam at Aerojet's Ballistic Missile Agency in Huntsville, Ala.

Lockheed Gets Order For Polaris Facility

Lockheed Missiles Systems Division has been awarded a \$1 million contract for construction of a substation facility for Polaris ballistic missile Navy's high cut growth project.

New facility, located at defense's Sunnyvale, Calif., plant will house test activities encompassing planning and maintenance, support and Navy administration under a single roof. Building will contain approximately 155,000 sq ft and will have high bay roof, two levels overhead handling equipment required in structural test area.

Aerojet General Delivers Titan Production Engines

Aerojet General Corp. recently delivered the first production two liquid fuel rocket engines for the Air Force Titan atmospheric ballistic missile to the Martin Co. Space Division. The Martin Co. is a prime contractor for the Titan.

The engine was produced in Aerojet General's 514-million-watt plant under contracting plant in Azusa, Calif.

Dr. Barnes Will Head Space Research Company

Spacetro Corp. of Venice has been formed to conduct research and development in space technology and will begin operations in 1967. Dr. Barnes, who is professor of engineering at University of California at Los Angeles, who also has been affiliated with various Aerojet and Aerojet companies in the Los Angeles area.

**TODAY'S FINEST
EXECUTIVE AIRCRAFT
FLY WITH**

**DEPENDABLE
CONTINENTAL POWER**



Behind the growing dependence on airplanes as adjuncts to business is the fact that for company after company they are more than paying their way. As planner and leader in utility aircraft power, Continental Motors leads solid satisfaction in its role as engine source for the outstanding planes of this type. It has every reason to believe that the performance of these engines—their power, economy and dependability as proven in thousands of hours of flying—has been not only a major factor in the leadership of these aircraft, but one destined to assure their even wider use.

CONTINENTAL'S INCREDIBLE RE-MANUFACTURE PLAN

... insurance in the periodic overhaul, leads you with the specialized skills of the men who know your engine best. With your factory re-manufactured Continental, you get new engine warranty—near log book with zero hours—at a modest, pre-determined price. Most important of all, you're back in the air with an absolute minimum of down time.

**FOURTEEN ENGINE MODELS
45 TO 320 HORSEPOWER**
In the line are two 4-cylinder and twelve 6-cylinder models, including four engines for military, and one for helicopter use.



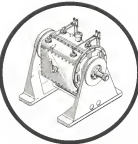
MODEL
A-65-140-1
of 320 hp.
1400
1400

Continental Motors Corporation

AIRCRAFT ENGINE DIVISION
MUSKOGEE • MICHIGAN

THE NEW AGE OF SPACE IS HERE

• In today's Air Force, with its technical training and flying proficiency with a "C-17" (C-17), actually, subsonic, regular only in process, and minimum after strong indications in the specified solution for the Air Force, Air Force, 7 D Box 7400, Washington, D.C.



Here is a view of a manual, model speed and load test stand as mounted on factory for guided motor pump. This unit has a top output speed of 50,000 RPM with a peak load velocity in excess of 30,000 RPM and a peak load of 240 watts per hour. One measure approximately 22 inches in length.

WESTERN GEAR

TEST STANDS and DRIVES...designed to

50,000 HP or 100,000 RPM

This gear test stand facility was designed for use by a leading Eastern aircraft manufacturer. The 3 diam turbines deliver 21,000 HP each. Top output speed is 9,000 RPM and the peak load velocity is 30,000 RPM.

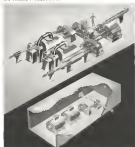
Western Gear is designing and building drives and test stands for leading machine-component manufacturers and development laboratories ranging up to 50,000 HP or 100,000 RPM. Successful tests have carried designs to 200,000 RPM. Pictured on this page are three recent applications. Note the coupon below.



Use this coupon or call your Western Gear Man in all principal cities.

Fill in name & Western Gear INFORMATION
 P. O. Box 1001, Detroit, Michigan
 Please send engineering data on your test stand and drive
 projects.

NAME _____
 COMPANY _____
 TITLE _____
 ADDRESS _____
 CITY _____ STATE _____



This test only presented an "impossible" problem... how to transmit 1,000 HP at 7,000 RPM through a right angle gear box! The well-mounted gear boxes are provided with speed change gear sets which can be shifted from 7,000 to 11,000 and 17,000 RPM. Inspection after unprecedented hours of service show the gearing as in excellent condition.

Scientists Disagree on Man's Space Role

By George L. Christian

Philadelphia—Disagreement between human factors specialists on the one side and systems engineers on the other on the role of man in manned space flight arose here during one of the first full-day discussions ever held on the subject in the U. S. Specific topics of debate was: How to design a control system for a manned space ship.

The human factors group, made up of twelve professionals in psychology, physiology, engineering and medicine, sought to keep man alert and alert during the long trip to such destinations as the Moon or Mars. They proposed a variety of jobs for man, among them: navigation, observation, repair of malfunctions on the space ship and landing and taking it off.

Travel Aids

Systems engineers prefer to put man to sleep during his voyage through outer space, and feed him automatically at trip length intervals.

Landing, as most and landing instead of the space ship itself, is to be programmed and controlled through the use of computers and automated controls, and could probably do the job of controlling the space ship better than man. Man, by having him sleep during the trip, will not have to concern himself to perform a job that no automatic machinery could do nearly so well, namely, explore his destination.

Guidance was given by National Science Foundation, Human Factors in Space Research and was sponsored jointly by the Human Factors Society of America and the Institute of Radio Engineers (Philadelphia Section). IRL Publications Group on Manned Space Flight, The General Electric Company was host and provided in charge.

An one panel, conducted as though it were a preliminary design team conference, the problem of developing a control system for a manned space ship led the engineers.

Panel chairman was Dr. John R. Brady, Support Systems Dept., General Electric Research Div., Westinghouse Corp. Panel members were Dr. D. C. Beatty, Radio Corporation of America, William, Man, Dr. J. C. R. Lathrop, Bell, Research and Development, Inc., General Electric, Man, Ives, C. Abbot, General Electric Co., Sr., N. V., Dr. A. Herberich, Air Research and Development Command, Baltimore, Md., and Dr. E. L. Hamilton, Electronics Dept., University of Pennsylvania.

Man's of the engineers debate as to take off from a launch vehicle, around the Earth, to the Moon, come into a considerable orbit between 50,000 mi. from the Moon (to do this the space ship must coast at a 5,000 mph descent into a 1,700 mph launch orbit) of the 10,000 mi. altitude from the ship around for reentry, braking and put it through a programmed deceleration.

If descending from 100 mi. above the Moon, the space ship would take 71 min. of time to fall free and the velocity at impact would be 1,500 mph. With a 1G deceleration, however, the fall could be checked in approximately the last 10 min.

Moon Takeoff

After exploration, the man would take the ship off again. During the orbiting of the Moon for the return journey, the man would have to watch such as energy fuel tanks, in the orbit then at off towards the Earth and readiness with the space platform orbiting around the Earth.

Space Flight Problems

Two major problems arise of human space flight on complex reliability of the propulsion system and heat and G forces control during re-entry. Gen. Don Phelan, Director of Human Factors, AEC, told American Work. Associated with the latter problem is development of an aircraft launch for the launch being in one of emergency situations or other major failure during re-entry.

Gen. Phelan stressed the fact that he was talking about a man entering the orbit for a relatively short time, "4 to 34 days," he said. He was not discussing planning a man to the moon.

"The problem is not when men were complex problems," he said.

The well-known opinions of weightlessness, effects of cosmic rays and sensor input do not give in much use on the last two problems, according to Gen. Phelan. Reason is that of both of these conditions are not fully understood. As he points out, the true problem of weightlessness, outside its effects and control input cannot be known until man enters the orbit. However, he took that the difference between predicted conditions and actual conditions as experienced by the first space man will be substantially less.

Still other problems to be solved are stress of developing normal attitude of man's space ship and developing accurate space means of controlling it.

The human factors group generally holds that man should have a role in a space mission, as well as well as use of his capabilities and use them to themselves, as with machines, also man and otherwise, as his capabilities will allow. The group also said a high speed as well as man to control the mission, to take advantage of his own.

There were different shades of responsibility, suggested for space man. Some thought he should act in a supervisory role between control and man, and possibly turn back if that appears like the desirable thing to do. Others suggested that he be, as a pilot, when the emergency procedure as they might occur. At other thought was that man should be integrated into the control loop and be used as a component of the control system. The function would be to take over from the automated control system when emergency conditions, such as a landing emergency, arise. All agreed that navigation was an open loop and that navigation was an open loop and that navigation was an open loop and that navigation was an open loop.

To these questions, no answers appeared. The basic question, he said, is that we will send out an unmanned space ship before a manned, and we will recover it.

Vehicle Control

Theodore, control is no problem for the human in a manned ship. His vehicle will be controlled in the same manner as the unmanned ship. However, whether it is a pilot or a machine, there are differences between the human and operation of the unmanned space ship make it impossible that all control could be entrusted to a machine space ship. For example, it is unlikely that an unmanned vehicle would be required to land and take off from the Moon, whereas this would be one of the primary uses of a manned vehicle.

Also, taking off on an unmanned ship is much more difficult than the capability of a man to control.

Finally, command, control, the space ship and its control requirements should be totally different between an unmanned and manned vehicle.

Some of the many opinions expressed by members of the panel and the audience at the symposium included that the space ship should include these four sub-sections:

- Pathological vehicle to control passenger health, diet, oxygen, humidity and other factors directly related to length of the crew.
- Navigational and guidance system.



Westinghouse proves performance of new J54 Turbojet

The J54... designed by Westinghouse as an investment in the defense of America... has passed a major developmental milestone.

Less than 30 months after design conception, the J54-WE-2 has:

- performed successfully... a 150 hour endurance test
- performed successfully... flight tests to altitudes limited only by the service ceiling of the test bed
- performed successfully... simulated flights, higher than any reached by operational turbojet aircraft, in an altitude chamber at the U. S. Naval Air Turbine Test Center

The medium thrust class, lightweight, single-spool turbojet has been designed for economical manufacture and operation. Continuing studies of advanced J54 configurations give promise of further selectivity performance in many applications.

Successful performance in this Westinghouse-financed J54 program typifies Aviation Gas Turbine Division capability. For J54 application data in convenient TAPE form, or general information on Westinghouse capacity, call your Westinghouse Defense Products salesman or write: Westinghouse Electric Corporation, Aviation Gas Turbine Division, P.O. Box 288, Kansas City, Missouri.

J 5400

YOU CAN BE SURE... IF IT'S

Westinghouse



Have You a Difficult PLATING PROBLEM?

Let our experience solve your plating problem.

For twenty-eight years, we have specialized in the finest types of precision plating.

Our technical knowledge, unexcelled plating facilities, and experience gained in working out customers' problems combine to offer you the best plating you can buy.

You'll be completely satisfied with Micro Chrome Plating!

NATIONWIDE SERVICE

Air shipments make us local platers in your community.

Fill out coupon and mail today.

**CERTIFIED BY AIR FORCE, ARMY, NAVY,
AND LEADING AIRCRAFT MANUFACTURERS**

MICHIGAN CHROME and Chemical Company



Dept. 18, 6615 Grinnell Ave., Detroit 13, Mich.

Please send complete literature on Micro Chrome Plating without charge.

- | | |
|---|---|
| <input type="checkbox"/> Silver Plating (101-102) | <input type="checkbox"/> Intermediate of Neoprene (100-101) |
| <input type="checkbox"/> Nickel-Cadmium Coating (100-101) | <input type="checkbox"/> Neoprene and Plastic Plating for Injection Molding (101-102) |
| <input type="checkbox"/> Lead Plating and Lead-Free Plating (100-101) | <input type="checkbox"/> Gold Plating |
| <input type="checkbox"/> Electroless Nickel | <input type="checkbox"/> Barium Plating |
| <input type="checkbox"/> Software Nickel | <input type="checkbox"/> All types of plating on Alloys and Stainless Steel |
| <input type="checkbox"/> Nickel Plating (100-101) | <input type="checkbox"/> Hard Chrome Plating—Finish or No Finish |

CITY _____

ADDRESS _____

STATE _____

NAME AND TITLE _____

which would be completely automatic over the ground path the vehicle must follow is known and because such a system is infeasible to automate.

• **Maintenance and repair facilities in space malfunctions in flight.**

• **Communications system with the earth.** This will be one of a top to the main, not difficult on a trip to Mars, according to the scientists.

Some of the environmental variables that are totally or almost totally outside the experience of the man on earth will be encountered this way.

• **Abnormal acceleration.** Very high Gs on blast off and long periods of zero G during cruise. Morning was warned not to expect a man to do much in the way of accomplishing tasks if he is subjected to such zero Gs during launch. At 15 Gs, he is quite incapable of doing much work.

• **Perception.** Very strong light on fresh arrival by the evidence of an almost twilight and uncontrolled dark will appear problems.

• **Total lack of visual reference points of zero earth.** Such man is hindered but zero at distances which he cannot interpret will become true.

• **Major problems of his environment—confusion, negligence, neither true that he is better than home than he has ever been before and that he may never return, the closeness of a distant pattern of these elements may influence a man's capability in a controlled and hence disturbing psychological effects on him.**

Weightlessness alone, for a period of weeks, will be much more than is equivalent period of complete isolation. Reduced excitement must be offset by old-fashioned sedation.

Other Suggestions

Among other suggestions relative to manned space flight were:

• **Anticipate all probable elements of flight and allow time to handle the unpredictable.**

• **Continuation of weightlessness and high Gs at takeoff will no longer be a problem for a flight to the moon or farther because as much experience will have been furnished prior to the flight while converting to and from the space platform and working around it during assembly of the space ship.**

• **Windows would be inadequate for looking out of a space ship.** Better solution is closed circuit, unintermittent television.

• **Edwards would be good space travel in time: they are not accustomed to the ground cycle. Suggestions was made that possibly a posthumous should or compare them to help them adjust to their new environment. (No comment was made on who would help the posthumous.)**



When Aircraft Engines Need Protection Most...

Take-off — the time when throttles are firewalled — when engine heat's near hottest. That's when aircraft oil must prove its dependability. *An engine's performance is only as reliable as the oil that lubricates it.* Today, 45% of the oil used by major scheduled airlines in the U. S. is supplied by Sinclair. There is no better proof of dependability.

SINCLAIR AIRCRAFT OILS

Sinclair Refining Company, Aviation Sales, 600 Fifth Avenue, New York 30, N. Y.

Heintz Achieves Volume Production with New Sciaky Counter Control Welders

In fabricating and job shops, where a wide variety of assemblies must be welded to rigid specifications every day, Sciaky resistance welding helps keep production schedules on schedule.

The Jet Engine Division of the Heintz Division, Kirby-Hoyt Company, a large Philadelphia contract fabricator, manufactures original and replacement parts for the aircraft industry. This means their production must meet existing jet engine specifications.

New Sciaky Counter Control

To help meet these requirements, Heintz now uses Sciaky Patented Three-Phase Resistance Welders with the new Preprogrammed Electronic Counter Control. This new unit provides precise control of all welder functions for absolute production consistency. All control settings are retained with extreme accuracy, and are readily reproduced at any time to duplicate previous production runs. The method cannot deviate from its setting.

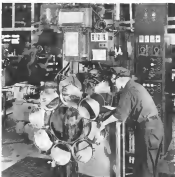


Fig. 1 Seam welding visually inspected on Pratt & Whitney Aircraft J-57 jet engine compressor duct assembly. Note clamps fixture used.

The Sciaky Preprogrammed Electronic Counter Weld Control is the only control of this type that has been proved in service, and the first use of this kind has now been in use nearly two years.

New Jet Works

The Sciaky Preprogrammed Electronic Counter Control counts the cycles of power line frequency which is governed by the U.S. Naval Observatory. It predefines absolute numbers, codes and impulses are supplied by a Delcotron tube to control the duration of the various welder functions. The absolute consistency of the control eliminates the need for time-consuming, pre-weld check-out as calibration. Plug in feature permits easy test replacement, or addition of other related functions if required.

Operations Performed

Photos show typical Sciaky resistance welding applications on jet engine parts—Afterburner, Nozzle Screen, Engine Root Assembly, etc. Multi-point welded nozzle. Nozzle Alloy, Stainless and Stainless Steel.

Information Available

Case histories outlining the successful use of Sciaky Resistance Welding Techniques on jet engine components are available on request. Specific recommendations will be furnished on receipt of an outline of your requirements.

Write today, mentioning the information you would like to receive. There is no obligation. Sciaky Ecom, Inc., 6515 N. 45th St., Chicago 30, Ill. PO Box 10747-7-30386. *etc*



Fig. 2 Seam welding Stainless in Nozzle on Pratt & Whitney Aircraft J-57 afterburner diffuser section.



Soviet's MiG-21 Faceplate Fighter in Mach 1.5 Class

Smest MiG-21 Faceplate fighter is a single-seat, 12,000-kg. (26,450-lb.) fighter. The high performance, high altitude intercept aircraft is a development of the MiG-19 Faceplate fighter. (Former has two turbojets, each rated at 13,000 lb. thrust.) Faceplate's low-speed maneuver is kept to match the MiG-19's, it is fitted forward on the fuselage. Now facing that extra load cockpit is tilted, and the two line which project from the fuselage behind the tail. Overall span of the aircraft is 35 ft., overall length is 58 ft. Faceplate was observed and photographed in Russia at Vladimir in 1976, at that time it was designated Super Faceplate by U.S. observers (A/E July 30, 1976, p. 31). In Faceplate, the ground layout of the MiG-19 is retained but a new engine section with a straight leading edge is used. Spike protruding from engine inlet forms inlet duct. Pilot visibility appears to be good, probably aided by the size.



IN ANY ATTITUDE THE F-105



Striking skyward or racing along "on the deck" . . . able to intercept or retaliate against an aggressor with powerful agility . . . the new Republic F-105 Thunderchief fighter-bomber brings to the United States Air Force a devastating weapon for defense.

REPUBLIC AVIATION
AEROMARINE, 1000 JEFFERSON BLVD.
In Dallas, it's the Republic THUNDER-CRAFT

AERONAUTICAL ENGINEERING

How T53, T58 Performed in Flight Tests

By Edwin J. Bellon

New York—First details of actual flight test experience with helicopter triad with two General Electric T53 and Lowrance T58 turboshaft engines indicate that this new generation of lightweight gas turbines provides significant breakthroughs in performance, schedule, safety and maintenance characteristics.

New 800-shp to 1,000-shp-class turboshaft engines are designed to power upcoming generations of helicopter. Evaluation of their installation in current model rotary wing aircraft promises to gain flight experience, was presented to American Society for Mechanical Engineers at recent annual meeting here.

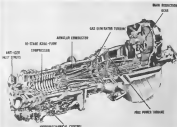
General Electric T53

First group of 22 flight test General Electric T53 engines produced for helicopter development testing had an average performance of 1,000 hp and specific fuel consumption of 0.67 at military power exceeding minimum guarantee, N. N. Davis, manager-in-charge, T53 project, Small Aircraft Engine Department, General Electric, told engineers. Some of these power plants delivered over 1,100 shp and showed 0.65 the average engine weight was 524 lb.

Free-baseline design encompasses 10 compressor stages and two turbine stages. The T53 has accumulated some 6,000 hr of development and open thrust testing experience, Davis stated. This includes 5,000 hr of helo, development trials, 700 hr of helicopter rotor operation and 100 hr of other testing including air wing, hot cell, alternate fuels and production test.

Three-stage installation as engine undergoing flight testing in a Sikorsky HH-53 and Vertol H-121D. Engine trial was a configuration that successfully passed 50 hr tests in August, 1956. First shipment of experimental test engines returned to General Electric for evaluation after accumulating 135 hr of test indicating that higher life was reached than had been anticipated.

Data obtained from test stand operation using a Sikorsky S-53 rotor drive is correlated to the paired T53 correlation check with actual flight test data with the complete vehicle. Davis noted. During a test stand operation, he reported, test engines automatically diagnosed power output signals and positively to maintain a rotor condition pos-



FIREF entry of General Electric T53 shows details of the 125 lb, 79 in. long, 16 in. diameter gas turbine. Two conditions are being split tested in Sikorsky HH-53 and Vertol H-121D. Sikorsky HH-53 will use single T53. Engine produces about 1,000 hp.

sively set by the pilot. During application of a burn engine "load burst" on the rotor engine at start, when collective pitch was increased to a depth of a second to simulate shock, both engine gas generators were operating automatically at a new power level to compensate with the new higher rotor load in about three seconds. Free power between speed dropped slightly due to a "speed drop" in the engine, fuel control that is designed to prevent engine engine stalling when the pilot varies rotor pitch.

Engine "Failure"

During the flight test program, engine failure was simulated by dropping the No. 3 engine power control lever to the idle position in a full-throttle T53 gas turbine as the T53 dropped from 670 to 10 in. rpm in approximately 18 sec, Davis noted.

Approximately 0.1 sec after the power control lever was moved, the engine failed, both fuel flow and torque started to increase as the remaining engine, in number 0.2 sec, the remaining engine began to increase. However, shortly after the No. 1 engine load peaked up the total rotor load and is operating at a new stable load power acting approximately equal to the total of both engines prior to the simulated failure.

General Electric has tested the T53's compressor in shock chambers at new

tested heights exceeding 35,000 ft. High test have covered operations at 5,000 ft. at speeds exceeding 160 mph right with the turboshaft. Data show delta, acceleration, angle and turbine engine loadings and rates of climb of 2,000 fpm.

Some early problems in testing included failure to start of the rear compressor stages, following some 2,500 hr of engine tests with 12 compressor assemblies, of which some showed over 100 hr operating time. Research stages in some cases even developed a fatigue condition in the back, dorsal, Davis reported. In three or four cases of blade erosion, only one of these resulted in complete separation leaving blade tips in flat spot, and causing local damage to the adjacent stator.

Data disclosed that the T53 operated for eight hours at military specifications schedule after the failure, without general rubbing on stator and/or distortion or power changes. Change in compressor efficiency was picked up only by the instrument group measuring rpm. The stage of 1400 rpm increased and a new set installed without taking the engine off the test stand and the test run resumed in 24 hr.

Investigation of the incident disclosed that fatigue was caused by excessive in the last normal mode at compressor speeds corresponding to nor-



special report to:

UNITED STATES AIR FORCE

Ballistic Missile Division

Air Research and Development Command

SUBJECT:

ASPECTS:

ACTION:

PACIFIC AUTOMATION PRODUCTS, INC. Systems Cabling Program
Fall 1966 forecasts by PAPI of benefits to be derived from establishment of sole responsibility for missile site cabling and activation.

The validity of our subject forecasts has been thoroughly tested by our service to USAF and Convair (Astronautics) a Division of General Dynamics Corporation. We have provided the services described below* for test and launching sites of the ATLAS intercontinental ballistic missile, with the following results:

1. All sites are being completed on or ahead of schedule.
2. 14,000 cables are now in service, with no malfunctions due to cabling.
3. Substantial savings are indicated by comparison of actual costs with predictions based upon former techniques and methods.
4. Superior design and simplified operational characteristics of completed sites are due to our integrated approach to cabling and activation.

CONCLUSIONS:

Original estimates of the benefits to be derived from PAPI services have proven to be conservative—actual performance warrants extension of PAPI services to other missile projects of USAF.

*HERE IS THE COMPLETE SYSTEMS SERVICE OF PAPI—THE SERVICE WHICH WE ARE NOW FULLY PREPARED TO OFFER TO ALL MISSILE AND MISSILE SYSTEMS CONTRACTORS



SYSTEMS DESIGN: Test Instrumentation, Launch Control **SYSTEMS FABRICATION:** Cable Components, Special Hardware and Checkout equipment **SYSTEMS INSTALLATION:** Instrumentation, Receivers, Transmitters, Controls, Computers, Air Terminals, Drive Data Cabling **SYSTEMS CHECKOUT:** Customer's in Charge, Specifications, Instrumentation, Systems (by ground), Test and Launch Control Facilities **SYSTEMS DOCUMENTATION:** Complete Operational Information in Approved Form

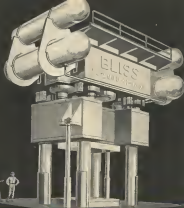
Address Inquiries to Arthur F. Jacob, Executive Vice President

PACIFIC AUTOMATION PRODUCTS, INC.

890 AIRWAY, GLENDALE 2, CALIFORNIA

Phone: CHelsea 5-9171 or CHelsea 4-8177

ENGINEERS: For exciting career in a company that is young, strong and growing, send your résumé today to Robert Hansen, Manager of Employment.



8,000 TON PRESS

... Especially designed for Kaiser Aluminum, this press is equipped with side cylinders for pre-forming stock. It can also be used as split die work for forgings requiring undercuts. Press design provides for eccentric or off center loading to compensate for non-symmetric forgings. This press has a wide range of controlled pressing speeds and is equipped with stripper and ejector mechanisms to aid in the production of difficult and precision forgings. Bolster size—84" x 72", Stroke—60".



5,000 TON PRESS

... Operates automatically, like the other two presses, through a solid advance into a controlled pressing speed and after a controlled stroke automatically returns. Thus, while the press operates at high speed, it has the high degree of control and accuracy necessary for precision work. Bolster size—84" x 60", Stroke—60".

NOW! INCREASED VERSATILITY AT KAISER ALUMINUM'S ERIE PLANT TO MEET YOUR FORGING REQUIREMENTS!

These three new hydraulic forging presses from the machines of Kaiser Aluminum's new expanded plant facilities at Erie, Pennsylvania.

Scheduled for operation by April, they will be capable of producing over half a million pounds of high quality aluminum forgings every month!

They are designed to complement the new 150 and 3500 ton hydrostatic presses now operating, plus a wide range of mechanical presses and drop hammers. These modern hydraulic presses will provide larger, more complex forgings to meet your military or commercial requirements.

Take advantage of our new versatility and increased capacity. For immediate service and complete information contact the Kaiser Aluminum sales office listed in your telephone directory. Kaiser Aluminum & Chemical Sales, Inc., General Sales Office, P.O. Box 100, Chicago 11, Illinois.



3,000 TON PRESS

... The smallest of the three, this press weighs over a half a million pounds and stands just under 30 feet high. Bolster size—72" x 54", Stroke—60". These three presses will provide you with larger draftings, precision and standard forgings. They will ensure no additional source of large magnesium forgings, and large aluminum and magnesium head forgings.



step into TOMORROW

...the fabulous world which electronic computers are helping shape today!

HELP YOURSELF to a dream... of material wealth that suggests the unimaginable—atomic power for transportation, complementary space travel—electronic miracles to take the drudgery from daily living—a world of super abundance. Actually it's all possible. Plan mag, development, engineering—spurred up through use of electronic "brains"—are already making our dream of tomorrow a reality. Tomorrow this end, the U. S. Gov-

ernment, Armed Services Industry and Science are joining forces for research and development. Only through the use of modern, large scale data processing systems can the complex calculations involved in nuclear development, space exploration, research, and electronics be solved with speed and accuracy. Building the road for future, more reliable and compact large scale data processing systems, Philco is proud to present TRANSC 5 2800



PHILCO Transtar Computer
The world's first all-transistor, large-scale data processing system.
*Model 5—Available at Philco Computer for Scientific Research Center

PHILCO GOVERNMENT AND INDUSTRIAL DIVISION
PHILADELPHIA 44, PENNSYLVANIA

At Philco, every operation is oriented to computer research, engineering and application. Look ahead... and you'll share Philco's

operating beyond the limit of present light altitude instruments, seemed only to Malldough, particularly at speeds below 50 kts.

Learning has provided a valuable reference to the HOK I by showing a new basis in front of the cockpit with a weather eye at the limit of the boom to give good indication of relative flight motion.

Reggie's Control

Lagging control in the 155 essentially consists of two speed governors: one controls gas producer speed, the other the power turbine or helicopter rotation. Both governors are sensitive to light so that the pilot can select governing rotor revolutions and the highest power at which he wants to operate. Only one of these governors has control over the engine at any given time, the being provided by going control in the governor which requires the least amount of fuel.

Tests with the HOK I tested have shown that the T11 installation responds rapidly to power demands by the pilot. Acceleration times from light idle to full power have been 5.5 sec. with approximately 13,500 rpm. on the light side gas producer revolutions setting. Another helicopter, Malldough noted, a spinning rotor gas producer light idle setting of about 17,000 rpm. so that acceleration takes approximately 2.5 to 3 sec.—indicating that it is not as rugged characteristic alone which determines response time, but rather one of engineering refinement.

The dual 155 installation in the Vertol 105 (H-21) has shown that concern about power matching a two-turbine multi-engine helicopter package has been exaggerated. A 1044 tie-down test on the 105 was completed with less than 12 hr. operating time and that flight was made about of schedule, Malldough pointed out.

Following the first flight, approximately 15 flights were made in the first series days after the event, and no power matching problems have been encountered to date, he added.

Navy Outlines Needs In Helicopter Designs

Navy studies of future helicopter requirements indicate that a power spectrum of from 40 hp. through 1,500 hp. will be required. Lt. Cmdr Robert Thoe, From Fleet Division, BuAer, told the American Society of Mechanical Engineers at a joint session of the American and Gas Turbine Power Divisions.

Lt. Cmdr Thoe reviewed helicopter requirements in relation to engine needs as follows:

• One-man subcyclic platform require

NEW "NO-MAG"

NON-MAGNETIC AIRCRAFT CABLES

ACCO
for Better Values

- GOOD THERMAL CHARACTERISTICS
- CORROSION RESISTANT
- HIGH FATIGUE RESISTANCE
- HIGH ABRASION RESISTANCE
- PERFORMED CONSTRUCTION

THE ACCO SWAGED TERMINAL

Eliminates Instrument Interference!

Just as we expected, many aircraft designers were interested in the newest advancement of our new non-magnetic aircraft cable. If you did not see it, "No-Mag" has these characteristics:

NON-MAGNETIC PROPERTIES

"No-Mag" cable is made from type 303 stainless steel. It remains non-magnetic after severe cold working—in contrast to standard stainless steel aircraft cable which shows a pronounced increase in magnetic permeability when drawing or bending operations.

This non-magnetic property of "No-Mag" cable eliminates instrument interference from cable magnetization.

CORROSION RESISTANCE

New "No-Mag" cables have corrosion-resistant qualities similar to, but slightly better than, cables made of standard stainless steel.

GOOD THERMAL CHARACTERISTICS

The thermal expansion characteristics of new "No-Mag" cables are much closer than those of standard stainless steel or carbon steel cables.

Get the complete story on this new technical development for the aircraft industry. Write today to demand a free.

to the characteristics of aluminum alloys used in aircraft. This greatly simplifies maintaining cable tension under various changes in temperature.

HIGH FATIGUE RESISTANCE

Duplicated construction and careful processing give new "No-Mag" cable high fatigue resistance.

HIGH ABRASION RESISTANCE

New "No-Mag" cable shows greater abrasion resistance than standard stainless steel aircraft cables.

TENSILE STRENGTH

While lower than that of stainless and carbon steel, is sufficient to enable replacing steel, can be used with "No-Mag" on many applications where the characteristics of "No-Mag" are required.

USE WITH SWAGED TERMINALS

Special terminals are applied to standard air dimensions.

COMPLETE RANGE OF SIZES, CONSTRUCTIONS...

...New "No-Mag" is furnished in sizes from 1/16" to 1" in all of the standard aircraft cable constructions.

**Automotive and Aircraft Division
AMERICAN CHAIN & CABLE**

601 Stevenson St., Detroit 1
2014 Southfield Ave., LeAnn Arbor 17 • Piquette 1 One





Medium Trainer Is Japan's First Domestically Built Jet

First photo shows the first of three T1B's ordered by the Japan Defense Agency for Air Self-Defense Force being built at the Kawasaki plant of Fuji Heavy Industries Co. Medium jet trainer is 40 ft long, 32.5 ft high, has 344 ft wingspan. Two-seater is designed to attain altitude of 40,000 ft, cruise for about 2 hr. at 20,000 ft. Top speed will be about Mach 0.85. All parts will be Japanese except turbine engine.

ing lightweight turbine fuel consumption engines in 50 shp class.

•Twinjet helicopter using 400-shp class engine.

•UH1H and observation type requiring 1,000 shp powerplant.

•Anti-submarine warfare helicopter, which will need 2,000 shp, 1,000-shp engines, having ability to operate a large amount of mine at high percent age of normal rated power.

•Mainwinging helicopter using 2,500-shp class turbine, capable of operating in unusual attitudes such as 60° or flat to attain side-completing helicopter problems.

•Assault transport requiring about 2,800 shp engine, no multiple installations.

•Fung class having great lifting capacity at expense of fuel consumption and range, a motor jet drive, for this requirement seems to be most efficient than a piston gas turbine. Civil, thus, avoid.

Current helicopter turboshaft engine projects falling in this spectrum include the 55-shp Sikorski T52 and 700-490 shp Boeing T60, 600 shp Lycoming T55, 1,800-shp General Electric T58, 1,600-shp Lycoming T55 and 2,500 shp General Electric T64. These are going to come to multiple installations open to provide power requirements of Navy and its future projects. Civil, three indicated.

Current Navy helicopter quantum problems requiring solution include: Means of protecting turbine powerplants from tail gunnery of dual dual and other foreign objects intended

while operating from unprepared air fields; protection against air-to-air engine parts ejected in tail air and spin (present designs are ineffective); and in a result Navy requirement call for elimination of engine parts in these areas in its engine design of fuel cooled components to meet minimum specification of 500-hr test using fuel contaminated with sea salt water, dust and sulfide fumes.

Rolls-Royce Turbojet Completes Type Test

London-Bath, Eng., reports that its General K. Co. II turbojet test engine has completed its official type test with a run of 17,150 hr.

The test was run to combined U S and U K specifications.

The company says a large part of the test actually was run at a substantially higher thrust. Specific fuel consumption is believed to have been lower than that of an expected military jet engine in the world.

Cost saving of the General is 16,500 lb. The first and General are to be delivered to Boeing and Douglas next summer. In addition to providing the American jet, General also are specified for the 15 Vietnam VC-119s in order for British Overseas Airways Corp.

The M. 2 Handley Page Victor bomber is to be equipped with the military version of the General.

Meanwhile, the Ministry of Supply announced officially the contract of the DCL 10 series of the de Havilland General Junior. No further details were given.

Cast Aluminum Alloy Cuts Costs, Weight

A new aluminum alloy, designated Tens-50 developed by North American Aviation's Los Angeles Division, is now being cast in quantities by Kaiser Aluminum and Mfg. Co., Gardena, Calif.

Tests cast in jet alloy are 25 to 100% stronger and lighter than those made from conventional materials and cost less than North American ones. One part which cost \$700 to produce by casting



D-21102 shows, below, jet's head is cast from Tens-50 to cut weight, add strength.

ing of five stock units about \$75 each in Tens-50, is equal in strength and lighter in weight.

Reason is jet casting the new alloy in a palm used to spread hot turks and handle four the T-500 Super Alloy. It has had a lower rejection rate, though. Now, examination of castings then is done when the pieces are cast in conventional materials.

Curtiss-Wright Cuts Turbomotors Staff

Indianapolis, Ind., Curtiss-Wright Corp. has been partially disbanded to a substantial move. The division, which was scheduled to move into its newly constructed quarters in Trenton, N. J., has been integrated with the Wright Aeronautical Division, the parent company, Curtiss-Wright.

However, it is likely that for the parent turbomotors will continue to remain a division of the Curtiss-Wright organizational chart under general manager R. W. Carlson, a Curtiss-Wright spokesman told Aviation Week.

The small team of 100 men according to a Curtiss-Wright source division was composed of factory design engineers, some formerly with Farnell Engine Division, Fairchild Engine and Marine Co., Deer Park, N. Y., who are making mostly paper studies under USAF contract on turbo-light weight gas turbine engines (AW May 28, p. 32).

Employees new quarter will now be occupied by Curtiss-Wright India and Scientific Products Division, which makes electronic testing and timing equipment.

Reason given by one former Turbomotors engineer for disbanding of the division was failure of power engine studies to materialize into engine development and production programs available to cost-conscious Curtiss-Wright.

Australia Plans Chain Of Strategic Airfields

Melbourne-Nine construction program to cost approximately \$7 million will mark the latest stage in the development of a chain of strategic airfields in Australia.

The \$7 million will be spent on construction in refurbishing of six airfields for RAAF's jet aircraft. The airfields at Mac. Springs and at Learmonth will be converted and three at Warrack, Warrack, N.S.W., East. East, Victoria, Perth, Western Australia and Ashby, Queensland, would be converted with two miles of bituminous concrete.

The Wilkesbarre and Allen Springs

projects will also benefit civil aircraft which use these airports.

Construction is still proceeding on the 15,000 sq ft strip at Darwin and at Farnfield. Brisbane work has been completed at Morris Island.

German Engineers Designing India's Jet

Bombardier of German aircraft company headed by Dr. Kurt Tank reports good progress on the supersonic jet fighter they are developing for the

personalized Hindustan Aircraft Ltd. at Bangalore, south India (AW Dec. 2, p. 37).

The next step reportedly will be the construction and testing of experimental models. Glob. After first, an India test form will the first model be designed.

It may take three years before the fighter can be put into operation.

Dr. Tank, general chief engineer of Heinkel-Werk, left Germany shortly after World War II for Argentina. After Peron's fall, he went to India with his staff.



MULTI-TUBE silencers have been flight tested on cross country flights by Boeing on the prototype 707 jetliner. Company and noise was comparable to that of its parent jet engine.

Boeing Flight Tests 707 Silencers

A complete new multiple design which includes a 21 tube sound suppressor compatible with a thrust reverser has made several cross country flights on Boeing's prototype 707 jetliner.

Flights which were made in late September, were made from Seattle to Los Angeles and Seattle to Wichita, Kan.

Suppressors also are installed on number one production 707 scheduled to fly later this month.

Boeing would not disclose the amount of the thrust and weight penalty imposed by the device.

Flights of the 707 prototype with the new suppressor delivered extensive tests of new different full-scale silencers in field on the plane at various times for a period of more than one year.

Cooperation of the aircraft industry, including suppressors were chosen on the basis of

laboratory tests of more than 500 small model silencers.

Tests with the 21 tube suppressor show that the device not only modified jet exhaust noise but changed the character of the sound so that it is "as much noticeable to persons in the vicinity of airports than the sound produced by present day aircraft," says Boeing.

In answer, the sound suppressor will be combined with thrust reversers and fitted as a unit to each engine.

Boeing's sound suppressor development began with the pioneering work of British scientists, notably Prof. M. J. Lightfoot of the University of Manchester, F. B. Gossard of Radio-Roy Ltd., and Prof. E. J. Richards of the University of Southampton.

Continuing the combination sound suppressor/thrust reverser has been several million dollars, including research, according to Boeing.



F-107A Design

North American's F-107A fighter bomber performing steep flight, has all-weather vertical and horizontal stabilizers, an outgrowth of the all-weather, high-speed fighters that were incorporated in North American's F-56 and F-108. Spoiler system for lateral control consists of hinged doors on upper and lower wing flaps that control plunge of air over and under wings during high-speed maneuvers. Maximum air speed is more than 1,800 mph.; the F-107A flies at about Mach 2 in level and climbing flight, exceeds Mach 3 in a vertical climb. Overhead duct was designed to provide maximum efficiency for the Pratt & Whitney J75 turbojet engine, which is in the 20,000 lb. thrust class. The F-107A has been selected for the high-speed flight studies of the National Advisory Committee for Aeronautics at Edwards AFB, Calif., for evaluation (AVW Nov 21, p. 27). Approximate dimensions are length, 63 ft., height, 19 ft., wingspan, 37 ft.

Details Include Belly Fuel Pod, Overhead Air Intake



DATARITE

examine test results immediately

HERE'S WHAT YOU'VE WAITED FOR—THE NEW CEC RAPID-ACCESS DATARITE MAGAZINE

- * Rapid access means a developed dry milligram in less than one second at 1000 up to 25 inches per second.
- * Direct attachment to any 5-119 Recording Oscillograph provides up to 30 standard pulse-converter recording channels on the record.
- * Rugged silver halide paper yields optimum contrast and resolution, records that may be duplicated by any conventional process.
- * The DATARITE-5-119 combination is the only rapid access data recorder that works equally well with either conventional or flash lighting.

Attractively priced, the DATARITE Magazine converts your 5-119 Recording Oscillograph to a 30-channel direct write! No modification of the oscillograph is necessary. Record capacity is 400 feet of 12-inch thin-base paper. Writing speeds of over 30,000 inches per second are standard with common sized silver halide papers.

For the complete story of the revolutionary 5-000 DATARITE Magazine, inquire at your nearest CEC field office, or write for Bulletin CEC 1330/33. CEC's 5-119 RECORDING OSCILLOGRAPH—engineered throughout the world for dynamic testing reliability—is available in both 36 and 50-Hz size 2 x 4 and 4 x 6 models. Write for Bulletin CEC 1330 X19.



Consolidated Electrodynamics

200 North Dixie Avenue, Fullerton, California

OFFICES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

EQUIPMENT

Manipulators Serve Nuclear Aircraft Units

Manipulation—again, electrically controlled mechanical hands which can perform jobs with almost the dexterity of human hands—are being used to maintain radioactive components of nuclear aircraft propulsion equipment at a large "hot" shop used by General Electric Co. at Idaho Falls, Idaho (AW June 24, p. 187). Nuclear-powered aircraft projects are labeled W3-125A.

Because of the relatively great distances between manipulator operators and components being handled, technicians must possess unusually good stereoscopic vision, which forced General Electric to establish a special stereoscopic vision screening program to select only those men with sufficiently good depth perception to perform the scanning tasks required in the hot shop.

Part of AEC

The facility, which is 160 ft long, 32 ft wide and 65 ft high is part of the Atomic Energy Commission's test operations.

General Electric says that the specially used hands used in the shop have the capability of disassembling a jet engine, repair "bush" in both Compressor appears to be working on one of its own J47 engines, judging from the silicon photo of the shop.

Two manipulators are used in the shop. One, dubbed "O'Man," is an entire mechanical arm suspended from a bridge crane so that it can cover the entire working area of the shop. The manipulator can handle from 100 to 5,000 lb of work, depending on the arm's length and position. O'Man was designed and built by General Electric. Also included in the shop are a crash cooler master-slave manipulator for setting intricate mechanical adjustments and four electrically controlled self-recording mechanical hands.

Manipulator operators are protected from radioactive equipment by concrete walls seven feet thick. The same windows in the walls are air-tight and are made of lead glass. Each window contains 500 gal of zinc borate to protect operators from any very violent nuclearities.

Radio Contact

Radio contact can be maintained by operators in the control galleries with other operating sites and with a lead shielded locomotive used to haul equipment in and out of the facility.

Enough controls are located at each



REMOTELY controlled manipulator moves radioactive equipment (above) at AEC nuclear propulsion test site at Idaho Falls, Idaho. Below, manipulator hands rest in technicians' window to operate any parts of arriving equipment in the entire work area.



Two large capacity trolleys on the floor of the shop are used to move the heavy equipment maintained in the facility, to provide easier access by the manipulators and to give a better view from any of the main observation windows.

A pool 120 ft long, 60 ft across and 24 ft deep, filled with very pure distilled water, is used to store fuel elements and other radioactive units. Pool is connected to the hot shop by a steel.

Also connected with the shop are several smaller shops for handling radio active equipment.

One of these has facilities for receiving O'Man and other remote handling equipment.

Shop is serviced by a railroad track system which enters the facility through large concrete controlled double doors at

A SPECIAL REPORT FROM GENERAL ELECTRIC ON

Variable-Stator Compressors: Key to More Jet Power Per Pound of Engine

In flight and test, General Electric's powerful J79 turbojet has proved to the entire aviation industry what G.E. personnel experts had predicted: the variable-stator compressor holds the key to greater jet power at low engine weight.

Compared to other methods of achieving high pressure ratio in a jet engine, the variable-stator method is simple. Variable geometry keeps engine weight down without sacrificing durability, provides positive compressor control. And because the variable stator

makes possible single rotor design, engines that use it are easier to overhaul and maintain.

Thousands of 270 flight hours in USAF's Convair B-58 and Lockheed F-104A have demonstrated the feasibility, soundness and dependability of the variable-stator compressor. Today, the sound of still newer variable-stator engines inside G.E. test cells heralds the approach of a whole new era of high performance jet flight. General Electric Company, Cincinnati 35, Ohio

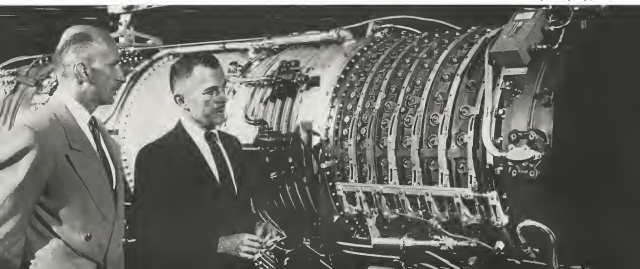


GE's commercial turbojet, the CJ-615, employs variable-stator compressor to help reduce weight, and to increase surface profile potential.

Progress Is Our Most Important Product

GENERAL  ELECTRIC

ELCUM: General Electric's Gerhard Neuman and Ned Dugan examine J79 variable-stator compressor. J79 is first U.S. turbojet to combine super-sonic power and light weight.



FLUTTER DAMPERS

by **HOUDAILLE**

... performance
proved for every
control surface
application

When flutter first became a problem on high-speed, high performance aircraft, Houdaille launched an intensive research program to develop high frequency flutter damping devices. Today Houdaille offers a wide range of designs in both rotary and linear types, to meet any control surface application — any engine requirement.

Houdaille Flutter Dampers are completely self-contained, precision-built by double construction—specified by leading aircraft manufacturers for their dependability and performance. Normally supplied with MIL-O-5600 fluid, available at all optional bases, they may be furnished with the new barbois-impregnated fluids when specified. A thermostatic valve assures uniform damping characteristics over a temperature range of -45° to 300° F and above.



CONTINUOUS TESTING and rigid quality controls are standard procedure at Houdaille. Production dampers must undergo extensive tests for several days on equipment such as this, to make certain each unit meets all phases of the customer's specifications.

WRITE FOR TECHNICAL BULLETIN giving complete performance and operational data. For engineering assistance on flutter damper applications at the several design stages, contact Buffalo Hydraulics Division, Dept. AV.



Several patented engineering applications are available in complete product literature for request.

HOUDAILLE INDUSTRIES, INC.

BUFFALO HYDRAULICS DIVISION

537 East Delavan Avenue • Buffalo 11, N. Y.

Pioneers in developing aircraft vibration-control devices



CONTROL room in protected lines work area by 7 ft. thick walls and 6 ft. thick slab plan walls (left). Roll-off transport equipment roller substation maintenance shop (right).

roller. Similar personnel entrance is also provided.

Universal problem in operating the test shop is to obtain personnel with sufficient depth perception to handle the manipulators properly while he is viewed from the object to be handled.

Two of the 6-ft-thick, windowless 10 ft above the shop floor and the one 18 ft above it. (North window is

in the handling equipment room below cell.)

Compensating the problem of achieving sufficient depth perception to operate the manipulators accurately is the fact that the size and color of the objects being handled are not always apparent to the operator, while the depth is obscured by shadowed hand depth perception.

To alleviate this problem, General

Electric provides each viewing station in binocular spotting telescopes, mirrors and closed-circuit industrial television systems.

Cameras in preparation to install a television network in the shop which will include black-and-white, color and three-dimensional stereo views, and are also located at three other viewing stations in all adjacent locations.

General Electric says that since the average person has only about 70% stereoscopic vision, and less than one percent in 18 his perfect stereo as well as perfect vision, the company has to select personnel who can develop 100% stereoscopic vision with a reasonable amount of practice and training.

To select manipulator technicians with sufficient stereoscopic vision to operate the devices with adequate precision, General Electric established this four-step personnel selection program.

- Examination of prospective manipulator operators by local auditors.
- Examination of candidates with less than 50% stereoscopic vision.
- Evaluation of candidates proving this test to determine whether they can handle the test material and complete within a day to improve their stereo vision.
- Installation of visual training and exercise, including the job training.

Engine Cleaning Facility Halves Costs

Oldford, Calif.—Automatic cleaning facility at Oakland Aircraft Engine Service's new engine overhaul plant adjacent to Oakland International Airport has reduced engine cleaning costs by 50% according to President Wilbur R. Rosen.

Machine is just a small part of company's modern and highly automated plant, completed last February. Plant size is 120,000 sq ft, twice as big as old facility at the airport. Its dirt, grease volume has increased sixfold since the move.

Company's biggest current contract is the Air Force. The firm has Civil Aeronautics Administration approval

for all aircraft engine overhaul operations in principal classes I and II. It handles engines in sizes Q390-C4 to R-2100, although most are R-985 and lighter horsepower. Using production line methods, the company overhauls four R-2500 engines and one R-3000 engine plus more than 1,500 components and spare parts daily.

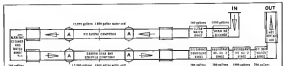
Cleaning a continuing spectrum of shops at Oakland Airport, where one builds, maintains and plating work is done, and a new two stories air located.

Oakland Aircraft Engine Service currently has 400 employees, but normally has more than 750 when business is seasonally heavy.

Cleaning system was built to meet prior specifications at a cost of \$275,000. An additional \$100,000 bought cleaning agents, which must be replaced constantly. Annual costs for chemical material are \$3,000.

Using the new cleaning facility, the company can accomplish in two 8-hr shifts what it formerly did in three shifts, when parts were loaded into tanks of cleaning solution, soaked for 8 hr, and hand-cleaned. Actual capacity of the new cleaning unit is 10 engines in a 16-hr day.

Cleaning process begins after engines are disassembled and inspected visually. Unserviceable parts get a red tag and



AUTOMATIC cleaning facility at Oakland Aircraft Engine Service operates like production line. Capacity is 10 engines in 16-hr day.



To protect jetliners from hydraulic fluid fires . . .

TWA SPECIFIES SKYDROL 500 FOR CONVAIR 880 JET FLEET

For improved protection against hydraulic fluid fires, all 30 jetliners in Trans World Airlines' new Convair 880 fleet will come factory-equipped with Skydrol 500, fire-resistant hydraulic fluid.

Skydrol is the practical solution to concern about danger from hydraulic fluid leaks. It is a fire-resistant, lubricating chemical, not an oil. Today, more than 700 airplanes in 40 of the world's major airlines are protected by Skydrol. They have logged over 8,000,000 flying hours . . . overwhelming proof that Skydrol gives practical

operation. Tomorrow, when a TWA Convair 880 speeds from New York to Los Angeles just a step behind the sun, it will enjoy proved service from Skydrol 500.

Jet- or propeller-powered, there's a Skydrol for your aircraft. Convenient from your present fluid is easy and costs comparatively little at overhaul time. Or, if you're ordering new aircraft, simply specify a Skydrol fire-safe hydraulic system as original equipment. Protect your planes and passengers from threat of a hydraulic fluid fire. Be safe . . . with Skydrol.

40 Major Airlines Now Specifying Or Using Skydrol...

JAL
ANA
Losa
Sik
JAL
CNA
KLM
SAB
TAL
GOL
Anaco
BOAC
Mexican
Panagra

Wanam
Alitalia
Swire
United
American
Brazil
Delta
Northwest
Norfolk
Cathay Pacific
Continental
Flying Tiger
Pan American

Canadian Pacific
Trans-Canada
British Airways
French Air Lines
Alitalia (Rome)
A.V.R. (Rome)
Ethiopian Airlines
FCA
S.A.S.
Air India
Capital
Eastern Air Lines
TWA

For more facts,
write today to:

MONSANTO
CHEMICAL
COMPANY

American Plants
Dept. AF-3
88, Locust St.
Monroeville

OFFENSE: P. M. Wessman Chemical Co.



WHERE CREATIVE CHEMISTRY
WORKS WONDERS FOR YOU



World's first twin propjet transport flies with Bridgeport Aluminum

Fairchild's revolutionary new F-27—world's first twin propjet transport—is ready to go into service as a principal short-haul and feeder-line carrier. Its outstanding features are high performance characteristics—propjet speed, reduced vibration and lower sound level, deluxe air-conditioned pressurized cabin and exceptional operating costs.

Playing vital roles in these modern 100 mph-plus class transports are light, high-strength Bridgeport Aluminum Extrusions. The new Fairchild F-27 is one of the many leading aircraft—both military and commercial—that rely on Bridgeport Aluminum Extrusions for dependable performance. The close tolerances . . . excellent finish . . . fast, on-time deliveries and other fine advantages make Bridgeport a dependable source for supply when high-strength aluminum extrusions and forgings are required. For prompt, dependable service, call your Bridgeport sales office.

NEW ALUMINUM EXTRUSIONS BOOK. Write us your first interest for a copy of Bridgeport's new 110-page handbook with complete information on standard shapes available, alloys, properties, losses, tolerances, pricing, etc.



For the very finest in
BRIDGEPORT ALUMINUM

Maximum Extrusions and Forging Facilities at Detroit, Michigan
Bridgeport Brass Company, Alcoa Aluminum Division, Bridgeport 1, Connecticut • Office in Principal Cities



SMALL parts of Oshkosh Aircraft Engine Service go from plant to cleaning facility on this system, are placed in baskets which are hung on overhead conveyor for trip through facility.

are set aside. These found visible or undesirable are carried to the cleaning facility by an overhead conveyor conveyor more than 100 ft long.

Large parts such as cylinders are hung from the conveyor line, while smaller parts are put in wire baskets which also are hooked to the line, either high or in pairs.

Automatic cleaning facility, located centrally on plant walls at 750 ft long, U shaped and made of concrete and steel. Parts go through a 1 to 20 min. cleaning process.

Parts are first plunged into an alkaline spray bath, where 1,000 gal of soap and water at 140-150° are used in the degreasing and cleaning process. This alkaline treatment plus a 700 gal clear water rinse, comprise the first two steps of the 10-step cleaning line. Other steps are:

- Parts are submerged in tank containing 12,000 gal of de-liming compound (Deto-Matrol 540) with 1-400 gal water and acid and part are removed. Temperature is 140°.
- Parts get another 140-150° alkaline bath and water rinse, make U-turn and begin final trip.
- Carbon is removed with 12,000 gal

of 80°F carbon tank and stopper compound with 1,400 gal water and

• Parts are rinsed in 700 gal of de-liming compound. (Product made in Wheeling, Md. Co. of California at workshop of No. 7).

• Rinse is repeated, using 700 gal and then 1,000 gal of solution (five steps).

• Parts get oil making in 700 gal tank of soluble oil and water at 140-150° to prevent rust.

• Final step is hot-air blowing system, which blows a dry air and dries parts. Temperature is 210°F. Parts refuse no paint and are removed from racks manually, loaded for return down production line for further inspection and overhaul. Only steps (five and six) are dip tanks. In other steps, parts are sprayed.

Cleaning is equipped with four fan operated agitation. Low can be removed for cold-dry or hot-dry operation, or can be used for cold agitated as hot-dry operation.

Over view across the cleaning system, checking for proper performance of the facility and the 150 hp. hoist which operates it, and keeping the area clean.

ARNOLD transistorized power supply

A regulated, lightweight, universal, built to withstand and maintain a full



FEATURES:

- Constant voltage to 100 millivolts
- 1/2 watt to 100 watt comparable dissipation
- 1/2 size of comparable dynamometer
- Unusual reliability for overloads and input voltage variations
- Hermetically sealed and encapsulated. Meets military environmental specs.

SPECIFICATIONS: Model 1001 A

Input Voltage: 20-50 VDC
Output Voltage: 100-2000 VDC
Output Power: 10 watts regulated
Load: 0.1 to 100 ohms
Load: 0.1 to 100 ohms
Size: 1.5" x 1.5" x 1.5"
Size: 1.5" x 1.5" x 1.5"

A. G. OUTPUT Model 1001 AG

Input Voltage: 20-50 VDC
Output Voltage: 100-2000 VDC
Output Power: 10 watts regulated
Load: 0.1 to 100 ohms
Load: 0.1 to 100 ohms
Size: 1.5" x 1.5" x 1.5"

PULSED OUTPUT Model 1001 P

Input Voltage: 20-50 VDC
Output Voltage: 100-2000 VDC
Output Power: 10 watts regulated
Load: 0.1 to 100 ohms
Load: 0.1 to 100 ohms
Size: 1.5" x 1.5" x 1.5"

Write or phone for literature



ARNOLD MAGNETICS CORPORATION

4615 W. Jefferson Blvd.
Los Angeles 10, Calif.
REception 1-854-4



Each B-52 Stratofortress, newest member of the Strategic Air Command, carries nearly 500 Tombs (see description of the types shown below). Important applications include tankers, flap devices and carriage assemblies and landing gear.



B-52 Tombs



B-52 Tombs



B-52 Tombs

B-52 Tombs



Show of strength...and stamina

Operation Power Flight first was way jet around the world flight, demonstrated the strength of U-5's power and the stamina of the B-52 Stratofortress, newest member of the Strategic Air Command.

It demonstrated, too, the real place worn in aircraft design and performance by Torrington Needle Bearings. These compact, lightweight balls provide the highest possible capacity in maximum cross section. Needle Bearings also provide efficient lubrication and smooth, uniform performance for long service life.

The Torrington Company pioneered the development of Needle Bearings, working with the aviation industry for thousands of installations of special aircraft bearing assemblies. Your Torrington representative will be glad to put this engineering experience at your service. The Torrington Company, Torrington, Conn.—and South Bend 21, Ind.

TORRINGTON BEARINGS

Domestic Offices and Distributors in Principal Cities of United States and Canada

BEARING - SPHERICAL ROLLER - BALL BEARING - CYLINDRICAL ROLLER - NEEDLE ROLLERS - BALL - THRUST



ACCESS doors to Hamilton Standard air conditioning system are shown on 580 wing.

Convair 880s to Get Freon Air Regulators

More than 52 million of them air conditioning equipment has been ordered from Hamilton Standard Division, United Aircraft Corp., by Convair for its 880 jet transport.

System will supply air conditioned and pressurized air for the plane's cabin and flight deck at a standard temperature of 71°F or higher or 60°F on the ground and will change the air completely every 2½ minutes. Pressure will be held at 4075 and cabin pressure to an operating of 5,000 ft when the plane is at 35,000 ft.

System will remove 240,000 Btu, per hr from the air circulating in the cabin. During normal cruising conditions, outside air superchargers will deliver 100 hp, but at its maximum speed at sea level, output can be raised to 600 hp. Unit's stainless steel housing will contain fragments of either turbine or compressor wheel in the event of failure. Turbine's maximum speed is 24,000 rpm.

The 580 will incorporate two identical air conditioning systems. Although

costs listed, each system can operate independently. Dual system has a capacity of 20 tons of air per 2½ hr period.

Components for cabin pressure regulators will be supplied by Avimatrix Mfg. Co. Hamilton Standard will be providing equipment for the first 48 880s in March, 1955.

Collapsible Container Saves Air Cargo Space

Now, lightweight, collapsible cargo containers for air cargo carriers have just been put into production by Jete Metal Fabricators, Inc., United Air Lines and American Airlines begin receiving them on one container each a few weeks ago.

Aluminum containers, which stand 5 ft high, can be collapsed to 14½ in. height—13 in.—by two men in less than a minute when it is to be disassembled back to destination. Other specifications of the containers are:

Weight empty, 210 lbs.; load capacity, 4,000 lbs.; outside length, 74 in., inside width 51 in., outside height, 62 in., outside depth, 156 in./ft., inside depth, 126 in./ft.



COLLAPSIBLE air cargo containers stand 5 ft. high, can be reduced quickly to 13 in.

Complete Aircraft Testing Facilities



- ✓ QUALIFICATION TESTS
- ✓ EVALUATION TESTS
- ✓ PERFORMANCE TESTS
- ✓ ENVIRONMENTAL TESTS

Aetco

AIRCRAFT EQUIPMENT TESTING COMPANY

1806-12 FLEET ST.
BALTIMORE 31, MD.

Aetco's first independent laboratory for testing mechanical components and systems.



A REPORT ON THE FIRST SUCCESSFUL PROCESS FOR CHEMICALLY MILLING LIGHT METAL CASTINGS

In high speed jets, rockets, and missiles the price tag on every ounce of excess weight is enormous. Even the use of lightweight aluminum and magnesium alloys wherever possible leaves room for improvement. For while part thickness is often determined by structural requirements, it is frequently a function of the networking processes used. Castings, for example, must have sufficient wall thickness to assure sound structure throughout. This is not always generally achieved by thickening the parts after casting. This is often an expensive and sometimes impossible task, especially where complex contours or dovetail joints are involved.

Enter Chemical Milling

The first hint came when a solution was discovered to the more problem as it affected wrought parts. The solution—familiar to every high school chemistry student—was based on the non-complexity of metals by powerful reagents. Its successful application to machining precision castings presented significant strides in weight reduction. But when the same techniques were applied to castings, results were extremely poor.

Rollé research immediately began laboratory tests to discover the reason for the failure, and found it often lay in the casting. Even minor impurities in the casting surface weakened the process of metal removal—refining as it defines present. Rollé also found, after much searching that only certain reagents in certain concentrations—depending on both the part and the alloy used—could guarantee success. It has taken almost two years of exhaustive research to refine this process to the extent that it can now take its place as an accepted metalworking technique. Parts can now be designed for casting that could only be constructed by sheet fabrication techniques in the past.

Half The Wall Thickness

The major advantages of this chemical milling process are pretty much wrapped up in the single figure 0.0007—the wall thickness which Rollé can consistently mill by the process. The importance of this figure is readily comprehended by comparing with it the maximum limit to casting wall thickness—22%. Rigid control techniques, developed in the laboratory, now permit an overall reduction

in dimensional tolerances of the part as a result of the chemical milling process. And at the same time, surface finishes of an order of 100 microinches or better can be consistently achieved.

There are two ways you can take advantage of this Rollé technique for chemical milling. One requires the total removal of metal from the entire surface area of the part. Allowance can be made in the pattern for holding heavy sections and critical dimensions despite chemical metal removal. The other method, useful where the areas to be lightened are relatively limited, requires masking of those areas not to be etched. The proper technique, of course, can only be decided on the basis of the individual part.

Since the success of chemical milling depends to a considerable extent on the smoothness of the casting shell, Rollé cannot promise satisfactory results on any but a Rollé cast part. But Rollé will gladly examine your parts and parts in light of this new technique and make recommendations or quote prices, as you desire. Furthermore, we'll be happy to answer any further questions you may have relevant to chemical milling or the work, precision metal, shell work, or investment casting of aluminum or magnesium alloys. Write Rollé Manufacturing Company, 380 Canyon Avenue, Los Alamos, N.M., or call UJ 445-5171.

ROLLE



F-104A Carries Jettisonable Pylon Fuel Tanks

Four pylon-mounted jettisonable 280-gal fuel tank carried under each wing of Lockheed F104A. Pylon structure can jettisonable. Tanks are 17 in. 6 in. long, base and diameter of 20.5 in. Five fuel tanks increase stability. F-104A is powered by General Electric J79 engine at 17,800 lb thrust. Engines are 54 in. long, 13 in. 6 in. high, but 21 in. 11 in. wingspan (AW Jan 21, p. 38).

WHAT'S NEW Reports Available:

The following reports were sponsored by The Office of Technical Services, United States Department of Commerce, Washington 25, D.C.

Development of Synthetic Analytical Procedures for Synthetic Lubricants and Their Additives. By F. A. Bessner, DuPont Research Foundation for Weight Air Development Center, U.S. Air Force, December 1957. 62 pp., (PB 131063).

The Effects of Nuclear Radiation on Military Specification Greases. Part I—by W. L. S. Sae, Wright Air Development Center, U.S. Air Force, December 1956. 57 p., (PB 123144).

Heat Capacities of Synthetic Engine Oils and Lubricants. By H. M. Mearns, Wright Air Development Center, U.S. Air Force, April 1957. 53 p., (PB 131130).

Strength and Corrosion Resistance of Ultrasonically Solidified Aluminum Joints. By J. B. Jones and J. G. Thomas, Acropolymer, Inc., for Frankford Arsenal, U.S. Army, March 1956. 51 p., (PB 123957).

Study, High Performance Cable Coating Unit. By A. P. Lane, Frankford Arsenal and Applied Corp. for Weight Air Development Center, U.S. Air Force, October 1954. 54 pp., 119 pp., (PB 121310).

Ultrasonic Welding of Metals. By J. B. Jones, C. F. DePrisco and J. G. Thomas, Acropolymer, Inc., for Frankford Arsenal, U.S. Army, April 1955. 52 p., 109 pp., (PB 131049).

The Application of Ultrasonic Energy to Cold Welding of Metals. By J. B. Jones and C. F. DePrisco, Acropolymer, Inc., for Frankford Arsenal, U.S. Army, November 1953. 52 p., 41 pp., (PB 131051).

Mechanical Properties of Unstayed Chromium-Br. By A. Spachner and W. Besseler, American Research Foundation for Weight Air Development Center, U.S. Air Force, December 1957. 62 pp., 74 pp., (PB 123105).

Research on Elevated Temperature Resistant Inorganic Polymer Structural Adhesives. Part 2—by H. H. Levine, Quantum Inc., for Weight Air Development Center, U.S. Air Force, November 1956. 57 p., 109 p., (PB 123108).

Publications Received:

Sixth Symposium on Combustion. by The Combustion Institute-Pub. by Reinhold Publishing Corp., 430 Park Avenue, New York 12, New York. \$18.00, 943 pp.

This book contains an available and growing source of new data, information on theoretical concepts, and principles of engineering applications for those working on the many aspects of combustion.

Civil Air Regulations and Flight Standards for Pilot-In-Command. by Federal Aviation Administration. Published by the Federal Aviation Administration, 1205 L Street, N.W., Washington 25, D.C. \$2.50, 160 pp.

This volume contains the new "Copy-Right" typical examination for Pilot-In-Command. It contains Civil Air Regulations that all pilots must know and abide by, plus pages of standard practices, procedures and information.

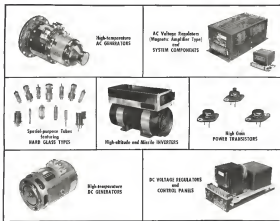


AIRCRAFT TUBING

GOVERNMENT SPECIFICATION TUBING IN STOCK

<p>4130 GRADE</p> <ul style="list-style-type: none"> • AMS - 8371 • MIL-T-8723 	<p>4135 GRADE</p> <ul style="list-style-type: none"> • AMS - 8373 • MIL-T-8725 	<p>1025 GRADE</p> <ul style="list-style-type: none"> • AMS-T-3556 • AMS-T-8726
---	---	---

SERVICE STEEL • DETROIT, MICHIGAN
LOS ANGELES, CALIFORNIA



BENDIX RED BANK—UNEXCELLED PERFORMANCE

AROUND THE  AROUND THE 

There's no questioning the quality of special-purpose electron tubes, electrical power equipment, or high-gain power transistors when they're made by Bendix Red Bank. The proof is an acceptance—almost universal acceptance. Twenty-four hours a day, in countries around the world, engineers like that shown above are proving that difficult design and expert engineering (plus an already unmatched quality control system) can build an international reputa-

tion for dependable performance. If you can use quality like this, call on us for recommendations. Write today for brochure, drawing, our engineering, production, and service facilities. RED BANK DIVISION, BENDIX AVIATION CORPORATION, EASTON, PENN. 19027.

West Coast Sales and Service: 117 E. Franklin Ave., Burbank, Calif.
Canadian Office: Bendix Canada, Inc., P.O. Box 610, Toronto, P. 6
Brazil Office and Service: Bendix S.A. Importadora, Rio de Janeiro, Brasil
New York Office: 120 E. 42 St., New York 17, N. Y.

Red Bank Division



AVIONICS

Technique May Offer 1,400C Transistor

By James A. Fries

Burlington, Mass.—A transistor that will operate at temperatures of 1,400C and duplicate those 100 are first, because a significant possibility as a result of new techniques developed here at Air Force Cambridge Research Center for producing silicon-silicon monoxide junctions in crystals of silicon carbide.

The technique is fast to execute, faster than present-day semiconductor operating temperatures and opens the way to high-temperature applications such as Avionics equipment for missile warheads without special cooling now needed.

Semiconductor research with silicon carbide is not new. Work with this material was first reported in Germany about five years ago. The Air Force Cambridge Research Center technique, however, is the first report of the successful production of junctions in solid state diffusion which is generally considered to be the most promising technique in terms of frequency, reproducibility and simplicity.

In addition to work being done in its own laboratories, the Cambridge Research Center has research contracts outstanding with Westinghouse and Avian Research for the study of silicon carbide semiconductors. Other companies studying the material at present include General Electric, Shockley Semiconductor Laboratory, and Ibm Instruments.

Work Needed

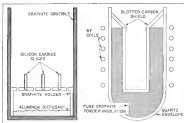
All parameters of silicon carbide as a semiconductor material and of the various techniques for producing junctions in the material have not yet been explored. An Air Force Cambridge Research Center spokesman told *Aviation Week* that work is still being carried out, the basic knowledge of this method and that much attention and basic continuing work is needed before application of these devices to a wide range of equipment.

The very first experiment, however, that the program had progressed to the point where more equipment and additional laboratory facilities could greatly speed the remaining work.

First advances on this research was contained in a paper delivered recently at the Semiconductor Device Research Conference at Boulder, Colo., by Miss Miriam T. Minamoto, Cambridge Research Center physicist. Quoted numbers operating tem-



UNTREATED CRYSTAL of light gray, n-type silicon carbide appears at top left. Some small as it appears after forming is shown at top right. A p-type silicon carbide has been created by the diffusion of aluminum into the crystal lattice, which gives it a black coat. Carbide (bottom left) holds crystals during diffusion run in 20 in. x 1 in. furnace (bottom right).



perature of 1,600C for silicon carbide semiconductors appears reasonable. Reliability of the material placed against temperature does not show a significant decrease or roll-off below 1,600 1,700C.

In conventional germanium and silicon semiconductors, several parameters are produced in one of three ways: by growing, by allowing or by solid state diffusion. The solid state diffusion method is the most recently developed and has the advantage of permitting close control of the base

layer width which, among other factors, determines the upper frequency limit of the device.

Both Air Force Cambridge Research Center and Westinghouse have produced p-n junctions in silicon carbide crystals. The Center has solid state diffusion techniques and Westinghouse has the growth process method. Thus, devices have been operated in the laboratory to temperatures of about 700C. Difficulties encountered at these temperatures are:

- Contacts and leads: Problem of fail-



Altitude—250,000 feet!

How do you straighten up and fly right?

*When the air gets too thin for aerodynamic
controls, there's only one answer—a completely
new type of automatic flight control*

MEANWHILE above 100,000 feet, pilots will face problems never before encountered. Rollers and eddies will be ubiquitous in the stratosphere. Reaction controls such as rocket nozzles angled to control roll and automatically controlled will be needed. Also, high Mach numbers and low static pressure will make the measurement of air data quantities inaccurate. Yet conventional computers rely on this data. Another problem: many situations at high altitude and high speed happen too fast for human control. How can reactions to these be performed automatically? The answer to these problems depends on the development of a new type of flight control system. This system will not only operate the aerodynamic and reaction controls, but, being an adaptive system, it will not require air data measurements.

Honeywell is making rapid progress toward development of such a system. Honeywell's new experiments in flight control systems, instrumentation and engine controls makes it the logical company, not only to do this advanced work, but also to solve your airborne control problems. Contact Minneapolis Honeywell, Aeronautical Division, 2600 Ridgway Road, Minneapolis 15, Minnesota.



Will a plane not at this work 250,000 ft? It is then when a reaction control system which uses high energy gas from small rocket motors are located in wing tips and nose. Control is produced by producing angular movements in roll, pitch and yaw. Development of an automatic control system for this type of reaction control is now strictly in progress at Honeywell Inc.

Honeywell

H Military Products Group

Aeronautical Division • Defense Division • Radio Division

ARMA'S SECRET WEAPON

Bug hunting... failure testing... safety factors... flight testing—none of these insures maximum performance of missile guidance systems.

We use them all at Arma—but the designer's

pencil is our "secret weapon." For true reliability must originate at the design stage—and then be implemented by a full-scale quality control and reliability program. ARMA... Garden City, N. Y. a division of American Bosch Arma Corporation.

4001

AMERICAN BOSCH ARMA CORPORATION

inter with leads and contacts is as found at temperatures over 700C. This problem is not completely solved, as in these cases are several processing approaches in its solution. One method is the use of ultrasonic soldering—a technique originally developed for the soldering of aluminum—leads, from the solid, through the oxide layer above present on the semiconductor surfaces. An other is the thermal compression bonding method reported by Bell Telephone Laboratories (NW Feb 76, p. 58).

• **Leptotrites and superlattices.** Certain materials available crystals of silicon carbide tend to be highly crystalline, not only do these properties affect the diffusion process, but also the minority carrier lifetime which is a function of this type is the lower parameter determining conventional transistor gain. Techniques used in particular of silicon are being explored here.

Metallurgical Problem

Basic problem remaining to be solved is metallurgical. Silicon carbide, as presently available does not approach the purity and crystalline regularity that is required for conventional transistors.

For transistors made of a material such as silicon carbide, the basic parameter determining the gain is purity, because this determines the minority carrier lifetime.

At Air Force Cambridge Research Center, work is being done to obtain a high degree of purity, from commercial cut-grade material. The process involves rough-slicing of the original crystals and building up of new crystals by vapor deposition. There are a number of problems with this technique because the crystals to be used must not only be without chemical contamination but must also have a grainlessly perfect crystallographic structure.

This problem has perhaps solved for silicon semiconductor with the development of the so-called floating zone technique. In this process, a rod of pure silicon is heated to the melting point at one end by inductors, heating. The width of the actual zone is carefully controlled in the heating, and passes along the rod as that surface temperature can hold the rod together. The silicon is then allowed to cool and develop its natural crystal structure with no contact with a contaminant such as a crucible.

Frequency Limit

One problem that must be solved before silicon carbide's high frequency limit can be compared (on common base) transistors is the determination of drift mobility of carriers in the material.

The ability of a material to pass some electrical characteristics at high

temperatures is a function of the width of its energy gap. The energy gap is the energy required to knock a valence bond in the material and liberate a pair of electrical charge carriers.

Usually, materials with wide energy gaps tend to silicon carbide have a consequence, lower carrier drift mobility, therefore a lower frequency limit. This is not, however, an inevitable rule and no accurate frequency limit estimate can be made until the specific drift mobility of this material is determined at the laboratory.

Performance of laboratory diodes made of silicon carbide generally is considerably better than that of conventional silicon diodes at normal temperatures. For example, forward current at reverse bias ratio at low values, of 10³ is given by Cambridge Research Center for silicon carbide compared with a value of 10⁷ for conventional silicon diodes.

The significance of the work, however, is that these devices have operated at 700C and are apparently capable of operating at much higher temperatures. There is little doubt that on the basis of this one characteristic, electronic devices will be much to improve the electrical characteristics of these devices in the same way that silicon semiconductor have been improved over the past several years.

Initial silicon carbide transistors

STEEL

Every Kind Quick Delivery

Aircraft Quality Alloys and Stainless Steels also bars, structurals, plates, sheets, tubing. RYERSON

Joseph E. Ryerson & Son, Inc. Plants
New York, Racine, Waukegan, Cook,
Palmadilla, Charlotte, Kansas, Chicago,
Cleveland, Philadelphia, Dallas, Milwaukee
Chicago, St. Louis, Seattle,
Spokane, Los Angeles, San Francisco

Waugh

AERIAL REFUELING FLOWMETER

Waugh model MF-42
Introducing turbine flow-
meter has been selected
for the tanker version of
the Douglas A7D
Skywarrior to give
precise measure-
ment and control
of fuel transfer



FEATURES:

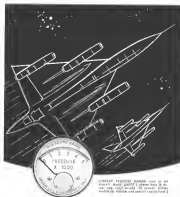
- Simple, reliable transmitter circuitry in flow sensor relays counter and signal light—no intermediate devices
- Signal light to indicate transfer of fuel is mounted directly from flow sensor
- Steady rotating turbine meter is the only flowing fuel-line relays or mechanical analogs

Write for complete data: Bulletin 120/AMF

Also available: Flow Rate Indicators and Receivers, Frequency Voltage Converters, general-purpose Flow Systems

Waugh ENGINEERING COMPANY
Flow Measurement and Control
2810 TARRANT AVENUE, VAN NUYS, CALIFORNIA

Circle 2-1022



NEW LINDSAY GAUGE designed for jet pressure systems

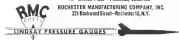
The LINC-Lindsay Pressure Gauge for jet aircraft is made for extensive cycling—will meet most endurance and over-pressure requirements. Not even the most extreme conditions of shock, vibration or temperature disturb its accuracy. Pressure ranges from 1,000 to 15,000 psi.

The LINC-Lindsay Gauge is a Bourdon tube type, using a single unit, helical Bourdon tube with the pointer attached directly to the end of the coil. The life of the Lindsay helical Bourdon coil, as compared to the traditional "C" spring Bourdon gauge, is more than 10 times greater and its great pressure range is maintained by a factor of 3 or 4. The helical Bourdon tube also eliminates the use of link and pin joints, increasing the gauge's shock resistance by a factor of 5 or 10.

The helical Bourdon element is, of course, not a new development. However, the LINC-Lindsay technique in coiling, heat treatment, calibration and material specifications are new and exclusive with LINC. Airtight front high pressure glass windows may be, why not let LINC engineering skill provide the answer. Write to either of the below addresses, enclosing your particular requirements.

ROCHESTER MFG. CO., INC. OF CALIFORNIA
92 Boston Place—Petaluma, California

ROCHESTER MANUFACTURING COMPANY, INC.
221 Rockwood Street—Rochester 16, N.Y.



also depend upon the development of intercontinental techniques. For example, one approach to the problem of obtaining point-to-point cable might be through the combination of point-to-point wire and cable.

Another approach might be to accept the integrity of present available cable outlook and attempt to develop devices that will operate within this limitation. Such devices might take the form of the amplifier transmitters developed by Dr. Wilhelm Shockley (the field-effect and other transistors discussed here in Proceedings of the Institute of Radio Engineers, November 1955).

The advantage of these amplifier devices is that they depend only on magnetic carrier transfer, where even basic bipolar transistors depend on transfer of both majority and minority carriers. Because majority carrier transfer is not subjected to recombination to such extent as the minority carrier, these devices appear to offer one practical approach.

Artificial Meteors Produce Ionosphere

Bedford, Mass.—Air Force has revealed that recently fired artificial meteors produced an artificial ionosphere capable of reflecting radio waves for almost one hour, opening the way to extremely long range transmission of VHF radio waves for communications, intelligence, missile guidance or telemetry and even submarine-surface television.

Artificial electron clouds were created at an altitude of about 75 mi., between 1° and 2° above the ionosphere. At Fort Cambridge, Research Center reports adding that the electron cloud was both persistent and reliable.

Transmission ranges of 1,400 mi. at VHF frequencies recently have been achieved by bouncing radio signals off the unusual man-made ionosphere. Natural ionosphere (AW June 17, p. 96). Natural meteor trails, however, last for only a couple of seconds, requiring extremely high speed transmissions and when a natural meteor trail is available, this is a product of artificial electron cloud will provide for greater operational flexibility and possibly greater reliable bandwidth.

Knowledge reports that additional experiments are scheduled as part of its Operation Starfighter to make full use of the possibilities of the new technique.

Moreover frequency of radio signals bounced off the artificial meteor trails has not been reduced. Signal Propagation Laboratory and several high speed radio stations throughout the Southwest participated in the initial experiment, Cambridge reports.

If your problem calls for MISSILE GROUND SUPPORT



Link's Design, Engineering and Production Abilities Provide the Answer

Link's capabilities in the field of electronic ground support have been built through the actual design and manufacture of precise electronic units delivered to satisfied customers.

Link's production methods are geared to manufacture electronic equipment to the most exacting specifications. Unique inspection techniques assure the highest standards of quality in every unit, large or small, that leaves Link's modern plants.

Alert management, experienced engineering and production personnel, and multiple research and de-

velopment facilities qualify Link to work for you. Link's capabilities include the development and production of such diverse electronic equipment as:

- Computers
- Missile Training Equipment
- Simulators
- Component Assemblies
- Optical Systems
- Go-No-Go Test Equipment

For complete information write or call Link Ritchie, Engineering Sales, Binghamton 3-6311 (Ext. 277). A brochure of our facilities is available on request.





wing muscles for the Lockheed Electra

Soon to be flying the nation's airways is the Lockheed Electra—a medium range, high-speed, prop-jet transport. Wing Flap Actuators for this nimble, fast climbing plane are being manufactured by the Speco Aviation Division of Kelsey-Hayes.

Kelsey-Hayes Company, General Offices: Detroit 32, Michigan

KH KELSEY-HAYES
Automotive, Aviation and Agricultural Parts • Hard Tools for Industry and Home
In U.S.A. and Foreign. Write for literature. Kelsey-Hayes Co., Detroit, Mich. 48201. Tel. (313) 487-1000. Telex 154-1000. Kelsey-Hayes Co. (Canada) Ltd., Toronto, Ontario, Canada.



DIGITAL, airborne digital computer now in production, performs target intercept, navigation and flight control functions in F-106



MAINT-IN test position permit speedy checkout of digital computer before each flight.



COMPUTER'S magnetic memory drums, undergoing lat turning alone, are over 3,500 1/2-inch wide.

F-106 Computer Navigates, Intercepts

New York—Digitalis, lightweight airborne digital computer which will perform target interception, navigation and flight control computations in the Convair F-106, was shown here for the first time by Hughes Aircraft which developed the computer as part of its F-106 integrated avionics package.

Hughes says the unit is the first airborne digital computer to go into production. It weighs 120 lb., occupies a volume of approximately four cubic feet. Present model uses vacuum tubes but Hughes has a transistorized version under development. Digitalis is an outgrowth of the Hughes Digital, the nation's first airborne digital computer to undergo flight evaluation, whose development was begun in 1948 (AW May 30, 1959, p. 62). Current model has undergone more than 1,100 hr flight test in a

T-29 and an F-102, according to John A. Rabal, director of Hughes' airborne systems laboratories.

Performs Many Functions

Digitalis is designed to provide automatic navigation of the F-106 to the target area by receipt of ground-transmitted data link commands, ground-based Tacan signals, or dead reckoning if the former are not available. Computer develops steering commands for the autopilot and displays information for the cockpit radar scope, Hughes says.

When intercepter is close enough to target for its own airborne radar to lock onto the target, Digitalis switches over to use radar data to compute steering commands and display information. Computer also determines when air-to-air missiles should be lowered into firing position, aimed and fired, and

accomplishes these operations automatically. After the attack, computer again takes over and directs intercepter back to assigned or alternate base.

Hughes says Digitalis can be used in tandem to provide automatic navigation, target approach, beam reflex, flight control and engine instrument functions and to direct defense equipment. Company also suggests possibility of using Digitalis in new jetfighters to provide automatic navigation, optimum cruise control and flight control functions.

However, Rabal says company is not actively working on this application at present.

Digitalis Characteristics

Hughes Digitalis is a general purpose computer, employing a clock rate of 100 kc, a modified two-address system of commands and a word length

Regulus II—Massive Air Power For Navy's "Undersea Satellite"

Construction has begun on the *USS Halibut*, world's first missile-carrying nuclear submarine. Meantime, the *Halibut's* primary weapon — Vought's Regulus II missile — is being flown repeatedly as a supersonic flight test vehicle.

Before long the two will be joined — a war submarine with advanced undersea range and a far-flying missile, ready to deliver a nuclear strike. You'll hear more about this "undersea satellite" when it begins its steady orbit through the deep waters of the world.

Right now — as a Vought engineer — you can help bring it into being.

Chance Vought has weapon systems responsibility for mating its missile with the atomic sub. Today, Vought engineers are designing the *Halibut's* missile support equipment. They'll help train submariners for Regulus II operation, and they'll be on board for check-out of the entire missile system.

Vought engineers introduced missile power to the Undersea Fleet with Regulus I. In the process, they traveled a new and exciting development route — from test range to shipyard to shutdown cruise.

Join them this time and share their advantage. Help forge from sea and air power an ultimate weapon.

USS Halibut symbolizes advanced capabilities of the Navy's 37,000-ton nuclear submarine force and signals a broad new frontier for weapon systems engineering at Chance Vought.

Now, inertial guidance for sea-going missiles

A new kind of guidance system is under development for Regulus missiles. It's being designed to provide longer-range guidance and finer terminal accuracy. It will be able to handle quick changes in launching position and variations in course. It must meet these rigid requirements in order to guide ship-based missiles.

This Regulus sea and air venture demands systemization of components much more sensitive than present-day guidance systems. It involves advanced development facilities—flight test aircraft instrumented for inertial guidance, and the Navy's extensive equipment for navigation research.

It's a unique new challenge for Vought engineers who will direct all development, design, systems work, and flight and sea tests.

Scientists and engineers pioneer with Vought in new missile, manned aircraft, and electronics programs. For details on select openings write to: C. A. Beiss, Supervisor, Engineering Personnel, Dept. A-25.



CHANCE
VOUGHT AIRCRAFT
INCORPORATED - DALLAS, TEXAS





Star trail photograph created by 1 min exposures of film while camera was located on Palomar.

WHAT IS SPACE?

Some 500 miles above the earth, a few solitary molecules of atmosphere are the final "land's end" of our small island in space—the outer reef beyond which lies an immense cosmic ocean so inconceivable that man had to invent a symbol (∞) to denote it.

How vast is this ocean, and what lies beyond our shores?

First, our own sea of stars: This is a giant wheel-shaped galaxy containing some 300 billion stars. Imagine a speck the size of a dust particle on the spoke of a cosmic carriage wheel 1000 miles in diameter. This is the relative size of our sun, one small life-giving star in the great procession. And beyond our galaxy, at least 100 million more such galactic systems are telescopically visible. The "weather" of this cosmic ocean is composed of stinging storms of cosmic radiation, distant clouds of interstellar gas, violent geomagnetic tides and currents, sudden showers of meteoric dust.

It is this weather that we first seek to understand. Much needs to be learned about cosmic rays, the nature of gravity, the physics of light, the true chemistry of "nothingness," the temperature of space, and the movements of the atmosphere on our small island below.

Our first few hundred miles voyage into space will be an infinitesimal step into the 600 billion billion miles of the visible eternity surrounding us.

MARTIN
BALTIMORE · DENVER · ORLANDO

at 16 bits plus sign. Memory (RAM), which varies at 1,000 words, has a storage capacity of 3,896 19-digit words. Computers can perform 46 different operations: eight arithmetic operations, 35 transfer and test logical choice and miscellaneous.

Digital can perform 3,000 additions or multiplications per second, 600 shifts, divisions or square root calculations per second. Relabel outputs.

In the 16-bit analog section, Digital samples 55 analog and 26 digital inputs per second, calculates total of 14 analog and 16 digital outputs per second. Digital performs all required analog to digital and digital to-analog conversions.

Expansions, Changes In Avionics Industry

Data-Control Systems Inc., Danbury, Conn., is one of new company wheels will develop and manufacture intra, extrinsic, control, computation and data handling systems. Dr. Robert J. Johnson is president. Company address: 39 Ross St.

Other recently announced changes and expansions in the avionics field:

• **General Atomics Corp., Bala Cynwyd, Pa.**, has formed new affiliate known as Avionics Products Inc. to produce equipment developed by the parent company. One of the first products will be an automatic sequential tester for checking printed circuit cards on a production line. Company address: 1 Bala Ave.

• **The Single Crystal Corp. of America** is a state of new firm which will produce crystals of various materials for electronic, optical and mechanical applications. Company address: Scarsdale Blvd., Scarsdale, Pa.

• **The Cathamelin Co.** will combine the Shapiro Division of Lumbic, Pa., Global Division at Niagara Falls, N. Y., and its Retrochron Division, Perth Amboy, N. J., into single division to be called the Retrochron Division. David M. Johnson, vice president, is named general manager of new division.

• **Magnetic Research Corp., Hawthorne, Calif.**, has formed new Solid-state Division to manufacture new line of electronic supplies. C. T. Davis is manager.

• **Control Data Corp., Minneapolis** computer development firm, has purchased Cedar Engineering, Inc., electronic manufacturing company, also of Minneapolis, through a stock exchange. New acquisition increases R&D by 10 percent and employs 155 people. R. J.

Guiding a missile, or speeding flight and flight environmental data back to control and tracking centers, is too much of a job for conventional communication systems. Superonic speeds call for lightning fast data communications, coupled with the utmost reliability.

Expanding on the ease of converting messages into digital form, Motorola scientists and engineers have developed a number of Data Link Communications Systems suitable for pilot aircraft, as well as missiles.

NERVE CENTER FOR DATA LINK SYSTEMS

Web Data Link Systems, messages that have been translated into on-off pulses can be transmitted by any of the common modulation schemes with a variable carrier. The transmitter can be airborne, ship borne, or land-based. Received messages are amplified, decoded, and transformed into a form suitable for display, or stored for some future time, or used for direct control through auto pilots, for example.

One of the Data Link Systems designed at Motorola utilizes an all-transistor converter-coupler, packaged in modular form. The total system consists of eight modules, each approximately 4" x 8" x 1 1/2". The fully transistorized circuitry is of the highly reliable dual-diode type (typical circuitry used in many digital computers). The switch type transistors employed are a product of the Motorola Semi-Conductor Division. Inductive of the stringent testing programs in which the transistors are subjected to a 1000-hour life test at 85° C.

For another Data Link program, Motorola has designed a system featuring modulator-type outputs. A single transistorized servo amplifier provides output of the five receivers in accordance with commands from the ground controller.

These two Motorola Data Link Systems aimed at solving one of the important communication problems of the missile age are examples of the complex programs conducted by Motorola for varied military needs.



MOTOROLA INC.

MILITARY ELECTRONICS DIVISION

Chicago Area Center • 6740 N. Elmhurst Ave. • Chicago, IL

Western Area Center • 8201 McGowan Road • Phoenix, Arizona

Positions open to qualified Engineers and Physicists



Manning, former president of Cedar Engineering, becomes vice president of Control Data Corp. and general manager of new division.

• **Rothman Manufacturing Co.** has opened new 42,800 sq. ft. laboratory in Santa Barbara, Calif. which will specialize in infrared, communications, communications and radar development. Laboratory employs 150 persons.

• **Office of Wincon, Los Angeles** receives assistance of Radio Engineers and West Coast Electronic Manufacturers.



Asia, will move to larger quarters at 1415 So. LaCorte Blvd., Los Angeles, on Dec. 1.

• **Lair** announces that the sales and service activities of the firm subsidiary, Lair S.A. of Geneva, have been sold to new Swiss firm, Elektronika S.A. of Geneva, which will handle Lair products in Switzerland.

• **Consolidated Avionics Corp.** will move to new 24,800 sq. ft. facility at Winthrop, N. Y. Industrial Park, in January. Company manufactures automatic test and data reduction equipment.

• **Hewlett Industries Inc., Racine, Wis.,** has purchased Worthington Electric's Universal Motor Division, whose machinery and equipment will be retained from Laue, Ohio, to Hewlett plant in Racine.

• **Mark Truitt Inc., Plainfield, N. J.,** has combined all its electronic activities into a single division to "perpetuate a greater concentration of effort" in the various field manufacturing operations will remain in Plainfield and research and development in Boston, but will report to single division chief, Robert Tilsade.

• **General Transistor Corp.** has located an additional 16,000 sq. ft. of facilities in Rockwood Hall, N. Y. Company now has five facilities in the New York area.

• **Fitch & Fenton Co.,** maker of precision instruments, has relocated its Chicago branch factory at 1331 So. 16th Ave., Normal, Ill., a Chicago suburb.

MUELLER BRASS CO.

ALUMINUM AIRCRAFT FORGINGS

PRECISELY FORGED TO ENGINEER'S SPECIFICATIONS
PRODUCED AND DELIVERED ON SCHEDULE... UNDER EXACTING METALLURGICAL CONTROLS

Mueller Aluminum Forgings for high tensile strength



Mueller Aluminum Forgings for light weight



Mueller Aluminum Forgings for low stress level



Mueller Aluminum Forgings for better machinability



Mueller Aluminum Forgings for resistance to corrosion



Mueller Aluminum Forgings for high accuracy

Write today for your copy of the engineering manual "ALUMINUM". Packed with photos, size cutters, and valuable data on Mueller Brass Co. quality forgings of Brass, Inconel, and Aluminum.



MUELLER BRASS CO.
PORT HURON 39, MICHIGAN

PRECISION RESOLVERS

WHEN A SYSTEM ERROR OF 8 MINUTES MAX. IS REQUIRED.

Two 15-4018-06 compensated resolvers can be used as a matched pair*

Oster



All units can be varied to meet your exact specification. Write for further information today, detailing your requirements.

ELECTRICAL CHARACTERISTICS

Unit	15-4018-06	15-4018-07	15-4018-08	15-4018-09	15-4018-10	15-4018-11
Rated (115 volt, 50/60 phase)	4.0	4.0	4.0	4.0	4.0	4.0
Input voltage to motor (volts)	115	115	115	115	115	115
Output (115 volt, 50/60 phase)	4.0	4.0	4.0	4.0	4.0	4.0
Output voltage to motor (volts)	115	115	115	115	115	115
Output current to motor (amps)	14	14	14	14	14	14
Output power (watts)	60	60	60	60	60	60
Output power (horsepower)	0.08	0.08	0.08	0.08	0.08	0.08
Output current (amps)	14	14	14	14	14	14
Output power (watts)	60	60	60	60	60	60
Output power (horsepower)	0.08	0.08	0.08	0.08	0.08	0.08
Rated (115 volt, 50/60 phase)	4.0	4.0	4.0	4.0	4.0	4.0
Input voltage to motor (volts)	115	115	115	115	115	115
Output (115 volt, 50/60 phase)	4.0	4.0	4.0	4.0	4.0	4.0
Output voltage to motor (volts)	115	115	115	115	115	115
Output current to motor (amps)	14	14	14	14	14	14
Output power (watts)	60	60	60	60	60	60
Output power (horsepower)	0.08	0.08	0.08	0.08	0.08	0.08
Output current (amps)	14	14	14	14	14	14
Output power (watts)	60	60	60	60	60	60
Output power (horsepower)	0.08	0.08	0.08	0.08	0.08	0.08
Rated (115 volt, 50/60 phase)	4.0	4.0	4.0	4.0	4.0	4.0
Input voltage to motor (volts)	115	115	115	115	115	115
Output (115 volt, 50/60 phase)	4.0	4.0	4.0	4.0	4.0	4.0
Output voltage to motor (volts)	115	115	115	115	115	115
Output current to motor (amps)	14	14	14	14	14	14
Output power (watts)	60	60	60	60	60	60
Output power (horsepower)	0.08	0.08	0.08	0.08	0.08	0.08
Output current (amps)	14	14	14	14	14	14
Output power (watts)	60	60	60	60	60	60
Output power (horsepower)	0.08	0.08	0.08	0.08	0.08	0.08
Rated (115 volt, 50/60 phase)	4.0	4.0	4.0	4.0	4.0	4.0
Input voltage to motor (volts)	115	115	115	115	115	115
Output (115 volt, 50/60 phase)	4.0	4.0	4.0	4.0	4.0	4.0
Output voltage to motor (volts)	115	115	115	115	115	115
Output current to motor (amps)	14	14	14	14	14	14
Output power (watts)	60	60	60	60	60	60
Output power (horsepower)	0.08	0.08	0.08	0.08	0.08	0.08
Output current (amps)	14	14	14	14	14	14
Output power (watts)	60	60	60	60	60	60
Output power (horsepower)	0.08	0.08	0.08	0.08	0.08	0.08

- Operating temperature ranges - 60°F to +100°F. • Meets MIL-E-8872. • Sizes 5, 10, 12, 15, 18 and 25 can be supplied. • Transformation ratio and phase shift to your design specs. • Functional accuracies as low as .05%.

Other products include servos, synchros, motor-generators, AC drive motors, DC motors, servo mechanism assemblies, servo torque units, motor fields, reference and tachometer generators, actuators and motor driven blower and fan assemblies.

John Oster

EASTERN OFFICE
227 North Main Street
Hartford, E. C. Box 100
Phone: (603) 288-1000
FAX: (603) 288-1000

MANUFACTURING COMPANY
Your Servicing Equipment Specialists
Avionics Division
Avionics Division

WESTERN OFFICE
2000 South Broadway Street
Denver, E. C. Box 100
Phone: (303) 733-1000 • Telex: 711100
FAX: (303) 733-1000

Engineers for Advanced Projects:
Extensive, varied work on designing transmitter circuits and servo mechanisms.
Contact: Mr. Robert Byrne, Personnel Manager, in confidence.

NEW AVIONIC PRODUCTS

Components & Devices

• Subminiature 18 w. resolver, Type R3110, is available in tolerances from $\pm 0.015^\circ$ to $\pm 0.1^\circ$ with a resistance range from 0.01 to 10,000 ohms, depending on tolerance specified. It is pencil mounted on aluminum, R3110



will dissipate 10 w., derated to zero at 275°C. It has an rating of 10 w. R3110 is not of a series of miniature resistors from 10 to 250 w. Request Bulletin R-118. Dale Products, Inc., Columbia, Nebraska.

• Diffused base silicon transistors, Types 2N477 and 2N478, are rated at 4 w. to handle the high temperatures commonly available. Low power and high power transistors. Four watt rating at 25°C case temperature, derated to one watt at 150°C. Both are type type transistors with a typical saturation resistance of 20 ohms at 25°C. Operating range is -55 to 150°C. Packaged in short round welded cases, they differ from each other only in collector to base and collector to emitter voltage ratings. The 2N477 is rated at 60 v., 2N478 at 100 v. Tecon Instruments, Inc., Box 117, Dallas.

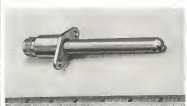
• Monolithic thin film, Type CK5607 WA, uses thin film technology and is used for both high and low power applications. Tube is used to have high vacuum capabilities, high permeability, radiation dose (10%), and contains for cathode emission as well as for maximum tolerance of cathode saturation current. Cathode current measurement for each section is 85 ma dc and total



New Thermocouple Measures Up To 3600°F.

Without Water or Air Cooling

Designed For Jet Engine Afterburners, Ramjet and Rocket Exhausts



A new, high temperature thermocouple probe, developed by Thermoelectric, promises to solve several serious problems of airborne or test stand temperature measurement. This probe was designed for use in the high velocity gas streams of jet engine afterburners, ramjet and rocket exhausts. The key to its performance is a ceramic (cermet) combination support tube and radiation shield.

This support tube replaces the need for water or air cooling. As a direct result, condensation errors due to cooling are eliminated and radiation losses to cold duct walls are reduced about 60%. Other disadvantages of water cooling—water supply, condensation, additional space needs, and other installation difficulties, are also eliminated. Equally important are the probe's construction—Phenomenal 675 Bladon, Phenomenal 305 Bladon up to 3600°F and Indium/Indium Bladon up to 3600°F. Thermoelectric's initial objective with this probe was a life in excess of five hours at temperatures of 3600°F or higher. It has already been tested at 3600°F, in a Mach 1 gas stream for 15 hours without failure. Tests are still under way to determine the ultimate operating limitations of the probe's structural elements.

Other Applications

Possible applications of this type of unit, however, are much wider in scope. Both construction and construction can be varied to meet a great variety of temperature measuring problems. The support tube itself, for example, can be formed to almost any shape. Other tube materials are also being investigated.

If you'd like further information on this thermocouple and how it can be adapted to your particular needs, contact Thermoelectric. Its development is typical of T.E.'s continuous progress in the field of high temperature measurement. Our extensive research and engineering facilities provide a complete service for the aircraft industry. Call us on the answer to your problem may be waiting for you.

"Progress
That Anticipates Progress"

Thermoelectric Co.

SALEM, NEW JERSEY

In Canada

THOMAS ELECTRIC (Canada) Ltd.

Scarborough, Ontario



Ready NOW for the big GPU job ahead...
the Jack & Heintz G180 a-c generator!

POWER MATCHED to advanced jet airliners!

It's already designed, thoroughly tested and ready for production, a new 168-kva generator — the highest rated machine ever designed for use in ground power units.

Power Matched? This new G180 has the same power and electrical design characteristics as the generators in today's superliners—guarantees the most precise check-outs . . . and it packs enough reserve power to preclude redesign or re-placement of GPUs in event higher power systems are put into aircraft.

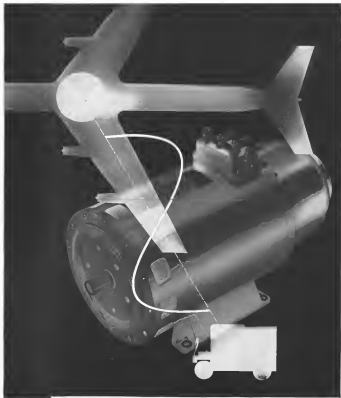
It is one-third the weight of comparable commercial generators . . . less costly . . . exceeds normal airline life specifications by being capable of a minimum 5000-hour life . . . will substantially lower maintenance costs.

The G180 is one of many a-c and d-c generators designed and built by Jack & Heintz for commercial and military use. For example, the J&H 720-amp d-c generator is the predominant power unit on military GPUs. More than 22,000 J&H a-c and d-c generators in support-equipment use have outstanding maintenance and service records.

Your inquiries are invited! Jack & Heintz, Inc., 17835 Broadway, Cleveland 3, O.

JACK & HEINTZ, INC. — A-C GENERATORS FOR GPU SERVICE						
In power, output voltage 480/415 volts, 3 phase, 4 wire						
GPU MODEL NUMBER	POWER (KW)	200/240-V	250/300-V	300/360-V	360/420-V	480V
Case (Series 100)	20	30	30	30	30	200/240
Int. Cooling Unit 1 or 2 in.	25	35	35	35	35	250/300
Case (Series 200)	400	400	400	400	400	400
Int. Cooling Unit	450	450	450	450	450	450
Case (Series 300)	1000	1000	1000	1000	1000	1000
Int. Cooling Unit	1100	1100	1100	1100	1100	1100
Case (Series 400)	168	168	168	168	168	168
Int. Cooling Unit	180	180	180	180	180	180
Case (Series 500)	250	250	250	250	250	250
Int. Cooling Unit	275	275	275	275	275	275
Case (Series 600)	350	350	350	350	350	350
Int. Cooling Unit	385	385	385	385	385	385
Case (Series 700)	450	450	450	450	450	450
Int. Cooling Unit	495	495	495	495	495	495
Case (Series 800)	550	550	550	550	550	550
Int. Cooling Unit	605	605	605	605	605	605
Case (Series 900)	650	650	650	650	650	650
Int. Cooling Unit	715	715	715	715	715	715

JACK & HEINTZ, Inc.
AIRCRAFT SYSTEMS AND EQUIPMENT



—61F to 506F

Frequency range is 40,000 cps with linearity of 0.1% of reading. In constant frequency, over the value range, it is insensitive to frequency deviation, according to the maker, and will produce a signal directly proportional to the reflector as low as the recording equipment will measure. Maximum dynamic range is 100.

Unit measures 14 x 22 in. and weighs under 100 ounces.

Consolidated Electronics Corp., 380 N. Sierra Madre Villa, Pasadena, Calif.



Metallic Snubbers

Snubbers to damp out high pressure surges and pump upsurges, allowing smooth pressure increase to protect air craft and marine pressure-sensitive instruments and controls, one of a series of new steel constructions.

Units are designed for operation with operating pressures up to 4,000 psi and burst pressure of 10,000 psi. They operate at fluid and ambient temperatures from -55F to 400F, with special models capable of working at 5,000F. Equipment comes in varying sizes down to 1/8 in. x 1/8 in. Typical weight is reported as 0.017 lb. for 1/8-in. line size.

A. U. Stone & Co., 25 W. 66th St., New York 23, N. Y.

Simulation Table

Two degree of freedom simulation table is used for angularly displacing mass and acceleration, in pitch or roll, either statically or dynamically. The servo-controlled table is used in conjunction with an analog computer to provide flight test conditions of an aircraft or missile stabilization system. Equipment may also be used as an



oscillating table to determine threshold characteristics of high performance gyros and accelerometers. Table will follow signals from an analog computer, a low frequency function generator, a tape recorder or a digital-to-analog converter.

Micro Tec Products, Inc., Box 1008, 5315 Clayton Ave., Culver City, Calif.

THIS IS ENGINE E7592

Airwork never assembles engine parts on a mass production basis. When this engine was torn down for overhaul—the parts went to the cart. The cart kept all re-usable parts together as they went through Cleaning, Inspection and Repair. Now, new parts have been added. The cart is ready to start through Assembly.

These cards guarantee your investment. If a vital part has a potential 10,000 hour life—and you have

used it for 1,000 hours—that's the one that goes back on your engine. Under the tunnel shop system, you could end up with a 5,000 hour part—and a big bill next time.

Mating parts that have "worn in" are re-mated. And—you get individual treatment of the operating problems shown by the internal condition of your engine at overhaul.

Only Airwork offers this individualized overhaul method—the best you can get anywhere.

Airwork
INCORPORATED
Millville, New Jersey

BRANCHES IN
WASHINGTON
NEWARK • ALBUQUERQUE
CLEVELAND



Stick Force Dynamometer

Model 518 stick force dynamometer contains a force balance to measure reaction force pickup after controls and does not need stick modification.

Group-designed unit is completely interchangeable with the B&B grip assembly, the manufacturer reports and is designed for 2150 lb. force and 40 in. lb. and 100 in. lb. loads, and the price is reported on each page.

Task Corp., 1009 E. Vermont Ave., Anaheim, Calif.

BUSINESS FLYING



BELL aircraft, using 47% less fuel on climbs over Chicago, demonstrate two marks out of six, despite cost of fuel adding to profits.

Bell Plans to Widen Helicopter Market

By Craig Lewis

It wasn't Bell Helicopter Corp. experimenting with new sales techniques in an effort to find the best method of merchandising helicopters. Sales programs have been extensively scrutinized in the past six months in Bell's search for the ideal commercial helicopter sales technique.

The aggressive approach to selling helicopters is designed to accelerate the growth of commercial sales and its financial worth for more sophisticated programs at the same time. And in crucial commercial markets will also improve Bell's ability to sell into the shade of unorganized operators' territories.

1957 Business

Bell sold more commercial helicopters in the first six months of this year than in all of 1956, and total commercial business for 1957 is forecast at about \$18 million. This includes all come from sales between the Bell training school. The company doesn't release figures on unit sales, but this year's business probably will come to over 1,000 units on the order of 100 helicopters.

Sales in 1957 are about 10% higher than this year in 1946, and this is much less in such the general growth trend over the past few years. Another 10% increase in commercial sales is predicted for next year. Bell has an eventual goal of \$25 million annual commercial business.

Bell believes that the growth of new world helicopter sales depends primarily on greater acceptance of the machine as a business tool. "It's a big educational job," Bell President Harvey Garland told Aviation Week, and he said that most aggressive selling will have to be educational in nature.

The view is echoed by Bell's new commercial division sales manager, Fred Rousso. The points out that greater use of helicopters will promote more helicopters and more aircraft facilities. As these facilities increase, the cost and convenience of operating and maintaining the helicopter will decrease.

The Kerosene was not the factor that really brought the helicopter to prominence. Rousso said, and in this, is off shore all development has made a valuable tool of maintenance. The operations of New York, Arizona, Los Angeles, Kentucky and Chicago Helicopter America also help in introducing the helicopter to businessmen through the ordinary channels of air transportation.

Rousso also points out that as the helicopter becomes more popular for business use, aviation businessmen will find new uses for it, thus creating new markets.

With this cycle of increased acceptance and use, commercial sales ought to gather momentum if some point and Garland and "we will be disappointed" if sales don't begin to rise well after another three years or so.

It, and that Bell expects sales growth to exceed the present rate of 10-15% a year when this momentum begins to pick up.

Higher production rates that account for higher sales volume could make another contribution to better sales. Current production of Bell's Model 440B is 4,000 to 5,000 units per year, the company could not print 40 to 50%.

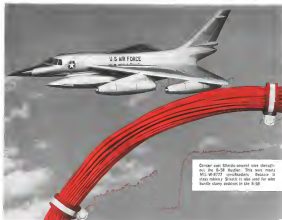
Stability Prospect

Let a government contractor take part in the space of financing with his budget, most commercial sales are expected to continue steadily. Bell figures a 50-50 split between military and commercial business would be ideal.

The end of a split, which Bell hopes to approach eventually, would permit the company to keep its focus on the military, but Bell's focus is in the current military budget cuts.

In general, a larger share of commercial business, Bell is experimenting with sales techniques to determine the best way to sell helicopters. In the past few years, the company is trying out techniques used to sell fixed-wing aircraft and Rousso left his job as domestic sales manager for Cessna Aircraft Corp. last summer to join the new program for Bell.

Where Bell formerly had three salesmen covering the country, there will now be eight salesmen and a district manager selling in the 48,000 sq mi.



Center can Silastic-encased wire throughout the B-54 bomber. This was made MIL-84677T (unclassified). Because it stays rubbery, Silastic is also used for wire bundle clamp systems in the B-54.

SILASTIC

SILICONE RUBBER

For resistance to heat, oil and solvents, specify Silastic US

Get latest data on Silastic. Mail coupon today

Free Catalog Company Dept. 87544
Midland, Mich. 480
Please send me latest data on Silastic

NAME _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____

TO: 300 N. ZEEB RD.

insulation stays rubbery at 500 F

Even continuous exposure to temperatures ranging from -130 to 500 F won't affect the resiliency or high dielectric strength of Silastic[®], the Dow Corning silicone rubber. Silastic resists moisture, resists weathering, ozone, aging and corrosion. That's why Silastic makes peak insulation efficiency for electrical wire and cable. Offered by leading wire manufacturers.

Typical Properties of Silastic for Wire and Cable

• Temperature range, °F	-130 to 500
• Tensile strength, psi	600 to 1500
• Elongation, %	100 to 450
• Tensile modulus, megapascals/5000 ft	3000 to 3800
• Dielectric strength, volts/mil	300 to 500
• Dielectric constant, 60° cycles per second, nominal	3.2

If you consider ALL the properties of a silicone rubber, you'll specify SILASTIC

First in
silicones

Dow Corning CORPORATION
MIDLAND, MICHIGAN



MANUFACTURERS demonstrate new built welding process. Goat was loaded in tank engine, mounted on loading gear for desman station.

guidance from Bell's main plant here. The sales territory east of the Rockies has been split up into four regions, and salesmen now operate out of New York, Buffalo, Cleveland and Ft. Worth. A fifth region will be added when a salesman now in training begins operating out of Chicago.

Western Plan

The western states are getting a different approach. Bell has set up a Western Division with a division manager in Los Angeles. The division is split into three regions, and the salesmen in those regions report to Los Angeles.

The Western Division operates at a sort of sales and service package deal Bell has a parts depot in Los Angeles stocked with the most commonly used spares, providing rapid parts delivery for customers in the western states. If this approach works out well, it may be extended to cover the country.

Telephone operators in the Western U.S. now have a Bell service representative to help them with their work, and a service rep will be provided for the western states. Operators in the central states can call on the Ft. Worth plant for help.

Salesmen use the model 471 for most demonstrations. Four of these machines are rotated through the regions biannually by the demonstrations two weeks out of town, using the other four weeks to set up demonstrations and follow up calls. One 47G-2 demonstrator is based on the West Coast, and another 47G-2 will be added in April.

Currently, Bell is producing the telephone intercom Model 47G-2 priced at \$79,500 and the plucker facepiece 47J costing \$24,100. Some of the older Model 47C and 47H com-



For fast single-point FUELING AND DEFUELING

Weight saving and simplification of loading operations are achieved through use of FRI GA-2 Adapter. This Adapter eliminates need for additional fueling points and associated plumbing by providing fast, efficient fueling and defueling through the aerial refueling probe on existing aircraft. The GA-2 Adapter fits an existing MA-2 fueling nozzle and gives positive check on the operator's status of aerial refueling receiver system during ground fueling thus eliminating need of expensive check equipment.

Designed and produced by Flight Refueling, Inc., these components are light-weight for production installations. FRI components simplify assembly and increase system flexibility.

Also Available:



PISTON VALVES for aircraft engines are lightweight less than 5 oz., reliable and extremely accurate. The CV-1 can be installed while by using standard loaded wire connections or it may be incorporated into any long tube easily by inserting a small section. These light-weight valves are positive sealing and feature low "breaking" pressure and low pressure drop. Reliability is provided by use with steel balls and gears. Operating temperature range is -40°F to 180°F.

1/2" PIPE CONNECTORS—These versatile, flexible pipe connectors with a telescopic sleeve configuration of pipes and tubing are assembly time and space savers. They are light-weight and pressure tight and secure the position of connecting loaded pipes in which high pressures must be accommodated. They have collectively not become lost or over 1/2 degree and have been tested over 15,000,000 cycles of compression without leakage. Sizes 1/2" to 4" of the shell, large sizes to order.

For specialized fuel system components in your specifications, contact Flight Refueling, Inc. Mass production prices consistently available.



Flight Refueling, Inc.

7700000 INTERNATIONAL AIRPORT, Suite 2, Airport

For High Strength-Weight Ratios up to 1000 F Specify New Armco PH 15-7 Mo Stainless

Guaranteed $F_{0.2}$ of 225,000 psi, combination of exceptional properties, and productivity, create new possibilities in design of aircraft and missiles.

These graphs illustrate only two of the many characteristics of Armco's new PH 15-7 Mo Stainless Steel that can help solve problems in the design and production of high-strength missiles and planes. Combining excellent mechanical properties up to 1000 F, corrosion resistance and good fabricating characteristics with productivity in all forms, PH 15-7 Mo meets all aircraft manufacturing requirements.

Higher Properties at Temperatures to 1000 F

On a strength-weight basis in the critical range of 600 to 1000 F, Armco PH 15-7 Mo is superior to other aircraft materials. Its tensile and compressive properties and creep strength permit the design of airframe and joint sub-elements that are more resistant to the combined effect of heat and stress.

Designs can be based on these identical guaranteed minimum properties:

Easy Fabrication Adds to Economy

Much less expensive than titanium alloys, Armco PH 15-7 Mo is also the most easily fabricated of all the high strength aircraft materials. This characteristic not only simplifies design but speeds production and cuts waste. Fabrication costs are low because stress relieving treatments are identical to those for widely used Armco 17-7 PH.

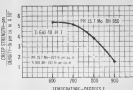
Commercially Available in All Forms

The new grade is available now in the form of sheet, strip, thin gage strip (foil), plate, bar, wire, and forging blanks. All are produced in commercial quantities.

Armco PH 15-7 Mo is the newest addition to Armco's family of workable precipitation-hardening stainless steels. Others are Armco 17-7 PH and 17-4 PH.

Write us at the address below for full information on properties, fabrication and available sizes.

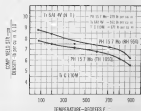
STRENGTH-WEIGHT RATIOS — CREEP STRENGTH
(0.2% DEFORMATION IN 1000 HRS)



Guaranteed Tensile Properties
Armco PH 15-7 Mo Sheet and Strip

	PH 950	PH 1050	A
Ultimate strength, psi	225,000 min	190,000 min	170,000 min
0.2% Yield strength, psi	180,000 min	150,000 min	135,000 min
Elongation, % in 2 in	4% min	5% min	25% min

STRENGTH-WEIGHT RATIOS — COMPRESSIVE YIELD STRENGTH



ARMCO STEEL CORPORATION

1917 CHASE STREET, MOORETOWN, OHIO

SHEFFIELD DIVISION • ARMCO BRASS & METAL PRODUCTS, INC. • THE ARMCO INTERNATIONAL CORPORATION

chances are still in transition and far off, although they are no longer as predictable.

Sales of the current production models are just about evenly split between the 47C-2 and the 47. While this is likely to change, between the two in performance, actual capacity and better loads seem to generate in more sales of the 47 as of the month closes 47C-2.

Helicopter a Commodity

Remote Tech the helicopter is a commodity, competing with any other 500,000 commodities, not just a helicopter competing with other helicopters. To back up this approach he plans to use modern marketing techniques to pinpoint the helicopter market, then develop new sales leads through experimentation to develop these markets.

But prospects for future development right now in the corporate helicopter field, according to Remote. He feels that interest in using the helicopter for travel between plants and to internal areas is increasing. Bell will push sales in this area, and Remote says that it will be a key to better growth in commercial sales.

Up to the time the sales program was reorganized this year, Bell told most of its helicopter to charter companies and other operators who in turn sold their services to industry. As interest has increased, these businesses have decided to buy machines instead of leasing them. So now Bell is concentrating more and more on direct sales to industry. Companies feel that the future growth in sales to charter operators will continue its steady upward curve and that new sales direct to industry will provide the extra growth Bell wants to expand its commercial sales base.

New Customers

Nearly 40% of sales this year are going to new customers. Bell will make the majority of its sales to old customers operating or expanding their fleets, but little or none of this is replacement business. Old helicopters seem to get chafed and kept in service, and given for good machines are looking up new well.

Charter operators form the largest single group buying helicopters this year with 37% of total sales. Foreign governments and military 32% for military forces, and 17% were sold for executive transportation. New buyers include new air taxi police use and oil industry applications. Other services were sold for mail use, crop dusting and spraying, flycatching, forestry, providing patrol and fishery work.

These sales figures don't give an ex-

Aircraft
Assembly
Engineers
prove it.



LAMINATED SHIMS OF



SAVE TIME! CUT COSTS!



With all laminations smoothly surface-bonded, LAMINUM looks and acts like solid metal, yet simply p-e-e-ls for a thousandth fit—right at the job.

✓ IN ALUMINUM

with laminations of .001"

✓ IN STAINLESS STEEL

with laminations of .001" or .002"—also available in 316 Steel and Brass.



LAMINATED SHIM CO., INC.
Attn: Headquarters Dept. 1012
4110 Union St., Glenside, Penn.



Extensively insulated shrouds have been designed to weigh less than 1/2 lb per square foot of surface.

A revolutionary new concept in heat control

The integrally insulated shroud . . . developed by Johns-Manville and proved on 5 supersonic aircraft

Here is an actively new approach to problems encountered in the control of high engine temperatures . . . an approach already tested and proved on the most advanced aircraft. It's the integrally insulated shroud suggested by Johns-Manville. This shroud is an actual aircraft part. It is supported by the engine or airframe. It minimizes the need for parts maintenance. And it prevents no removal problems for engine maintenance.

Essential to the development of the J-M shroud was the perfection of new techniques in fabricating

exclusively this role of stainless steel, titanium and other high heat-resistant alloys. These materials are combined with Thermox® refractory fiber felt in a sandwich construction. The result is a strong, lightweight unit with greater heat control and flame protection than any other shielding device.

J-M insulation specialists wish to be happy to demonstrate for you the design advantages of integrally insulated shrouds. Just write Johns-Manville, Box 34, New York 30, N. Y. In Canada, 345 Lakeshore Road East, Port Credit, Ontario.



JOHNS-MANVILLE

early accurate portions of the proper board and made of the helicopter, since it is impossible to tell what the large segment of their operation are using these machines for. But they do put an indication of Bell markets for direct sales.

The best market for Bell's sales efforts right now is probably the group of companies which operate fixed-wing aircraft. They are already awarded, and they have the right organization and maintenance setup to handle a helicopter easily. Roscoe said this group will be a primary sales target.

Tied to Jets

Roscoe thinks that as more companies move on to turbine-powered fixed-wing aircraft, this will have an increased need for helicopters to help with their involvement in jet aircraft. In order to take full advantage of the increased speed of the jets, operations will have to cut ground time between the biggest, more remote airfields needed for the jets and the point or down town after.

This year, about 50% of Bell's non-military sales were made to various customers, compared with 55% last year. This is in line with the declining trend from a point six years ago when 70% of sales were for export. Bell's overseas dealers must compete with companies in Japan and Italy licensed to build and sell Bell helicopters, but the company figures it can handle about 5% of its overseas customers to them. Most foreign sales are made in soft currency areas where Bell couldn't afford to do business earlier.

Bell's president Gerald Galt, said that a state signature and more significant sales effort can greatly expand commercial sales with the helicopter now available. He does not believe that any technical breakthrough or radically improved machines are needed before the helicopter can be widely produced in an accepted mode of business transportation.

More Sales Effort

Galt said that technical breakthroughs are always desirable, but he says that improvement can just as easily come from new tools and materials applied to present tools. He believes that greater sales effort and a better service, is needed to increase sales.

Turbine power represents a new era in helicopter development, but Galt said that Bell's goal is to have a family of small turbine engines available which is suitable for adaptation to a spectrum of the jet's use.

He thinks the turbine-powered H-40 that Bell is currently developing for the Army may well have commercial applications similar to those of the H-35 now in the field.

This new PAYMOVER will handle



model T-3005
30,000 lbs.
drawbar effort

all JET and TURBOPROP airliners

Recently demonstrated at the Air Transport Association meeting in San Francisco in late October, this T-3005 "PAYMOVER" towing tractor is the only tractor of its size and type in operation today. Acclaimed by all who saw it as outstanding in both performance and appearance the model T-3005 is a modern tractor in every respect, with plenty of power, traction and speed to keep your plane-handling operations up-to-date for years to come. Here is ground-handling power of its best — 21 tons of tractor that a boy can handle — that will deliver anything from a gentle nudge to a 30,000-pound drawbar effort . . . that will "inch" a load, or move up to 25 mph in other directions.

OUTSTANDING IN FEATURES AND PERFORMANCE

POWER: 345 H.P. 4 cylinders, heavy-duty compression or diesel (optional) turbo, full 210° steering capability.

TRACTION: 4 wheel drive, torque gas parking differential, planetary front drive.

SPEED: up to 25 mph, water brakes, 4 speeds forward or reverse.

SMOOTH GENTLE ACTION: torque converter drive for fast clutch.

EASY OPERATION: power steering, power brakes, power shift, low torque clutching.

SAFETY: ground-air speed indicator, 4 wheel brakes, anti-lock parking brake, full 210° steering capability.

MANEUVERABILITY: steering, tow, clutch of front wheel clear or over wheel chain or built at the same time — for tight turns and the widest turning radius up to 34 degrees right or left.

ADAPTABILITY: 24 Volt Starting and lighting system is standard equipment. Gas turbine, compressor and other accessories can be supplied.

For complete information on the year-around model T-3005 or other modern "PAYMOVER" tractors (from 3,000 lbs. drawbar), contact the nearby Hough Distributor, or write The Frank G. Hough Co., 927 Sutcliffe Ave., Libertyville, Ill.



PAYMOVER
A HOUGH COMPANY
THE FRANK G. HOUGH CO. LIBERTYVILLE, ILL.
Model T-3005 shown with 30,000 lbs. drawbar effort



AVIATION SOURCE December 16, 1983

right m-strength Elastic Stop[®] nut from ESNA'S broad product line

HIGH STRENGTH SHEAR BOLT

Such as Type NAS 333



1610
Nut-hex, 250 °F

ULTRA HI-TENSILE (220,000 PSI)

Type Bolts



N3220
Nut-barrel, floating
350 °F

180,000 PSI BOLTS

Such as Type NAS 624



EB
Nut-double hex, 250 °F



ZEB 1845
Nut-double hex, 550 °F



2552
Nut-barrel, floating
lightweight, 250 °F



2452
Nut-barrel, lightweight,
250 °F



LH2577 (NAS 577)
Nut-barrel, floating
550 °F

160,000 PSI BOLTS

Such as Types MS 20004
and NAS 144



ZEB 1845
Nut-double hex, 550 °F



1610
Nut-hex, 250 °F



2752
Nut-barrel, floating
250 °F



1452
Nut-barrel, 250 °F



NA101
Nut Anchor, Two Lug
250 °F

The high loading inevitable in today's supersonic aircraft designs makes it essential that the entire structure be strengthened—with a minimum increase in weight. In fastening, this means that fewer but stronger fasteners are desirable. To meet this need, ESNA now has available a complete line of high tensile self-locking nuts to match the full temperature and tensile range of the high strength bolts. There is also a wide variety of nut "shapes" to cover a broad range of structural application requirements.

We will be glad to send you complete details on any of the nuts shown here or to help you with any of your specific fastener problems. Just write Dept. N45-1225.



ELASTIC STOP NUT CORPORATION OF AMERICA

2330 Vauxhall Road, Union, New Jersey